ESSENTIALS OF DIETETICS

By AMY ELIZABETH POPE

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A QUIZ BOOK FOR NURSES

ANATOMY AND PHYSIOLOGY FOR NURSES

A MEDICAL DICTIONARY FOR NURSES

PHYSICS AND CHEMISTRY FOR NURSES
(WITH ANNA CAROLINE MAXWELL)

PRACTICAL NURSING

DIETARY COMPUTER

MANUAL OF NURSING PROCEDURE

ASISTENCIA PRACTICA DE ENFERMOS
(Spanish Edition of Practical Nursing)
CON LA COOPERACION DE ANNA CAROLINE MAXWELL

Essentials of Dietetics

In

Health and Disease

A Text-Book for Nurses

And

A Practical Dietary Guide for the Household

By

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PREFACE

IN writing this book the authors have kept constantly in mind three guiding principles: that it should be precisely adapted in plan and scope to the needs of nursing schools; that it should make a useful dietary guide for the home; and that it should be sufficiently comprehensive to include the essentials of its subject without being so large as to bewilder readers by the inclusion of a miscellany of unessential information.

Well cooked, nourishing food is all-important for the maintenance of health; and improper, or even improperly cooked, food is conducive to disease. It is, therefore, of primary importance that those entering a profession which offers unbounded opportunities to teach prophylactic measures, and which will place many of them at the head of institutions where good food and economy are both indispensable, should have a very general knowledge of the following branches of dietetics: the rules which govern the

cooking of the various classes of food; the true cost of food with relation to its nutritive value; the average amount of food required per capita; the common adulterations of food, and the methods of preserving it; the underlying principles in the making of dietaries, and in the feeding of infants, children, and the sick.

To attain this knowledge it is necessary, especially for those who have not had much practical experience along these lines, to know something of the chemical composition of the various foods, and of the changes caused in them by the action of heat, of chemicals, of digestive ferments, and so on; to know also of their various uses in the body, and of the relative proportion of food principles contained in the different foods. To put in other words what is implied in what was said above, it is the object of the present work to give the most important facts relating to these subjects, and point to their practical application in a sufficiently concise form to allow of their being thoroughly mastered in the short course in dietetics included in the curricula of schools of nursing.

Sufficient recipes for class use are included, and those chosen are such as tend not only

to demonstrate the practical application of the lectures, but also to call attention to a few of such easily prepared dishes for the sick and the convalescent as every nurse should know.

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CHAPTER I

USES, CLASSIFICATION, AND SOURCES OF FOOD

KNOWLEDGE of the nature of food constituents, of the changes wrought in them during digestion and metabolism, and of the different ways in which the various ones are utilized in the body, has led to the placing of proper feeding among the most important measures for the prevention and cure of disease. The reasonableness of this is obvious when one realizes what an extremely intricate piece of mechanism the human body is and that food is the material used (1) for building its tissues; (2) for repairing the substances of tissue that are broken down as the result of body activities; (3) for manufacturing the secretions, hormones, enzymes, etc. (described page 64), which are essential for many of the vital chemical reactions occurring in the body; (4) to provide fuel to keep the body warm and to yield the energy required both for the movements of the external muscles and for those activities of body

structures which are essential for life. The heart, lungs, muscles, and other organs are all as dependent upon fuel for their energy as the machinery which forces the ship through the ocean is dependent upon the coal burned in its fire-box.

Unlike the material of ordinary machinery, the body substance itself can be burned if fuel is not provided. This, however, can occur only for a short time or death will ensue; one reason being that the body retains but a limited supply of some of the substances derived from food that are necessary for life and, as all the matter of the body is gradually broken down and eliminated, this supply will soon be used up unless the loss is made good.

Experiments have shown that, for the maintenance of health and body growth, not only is a sufficiency of food as a whole necessary, but that, as different food constituents serve different purposes, an adequate supply of all essential ones is of importance—and all such constituents are not present in all foods.

On the other hand, in many ways that will be discussed later, the taking of any kind of food in excess may be almost as injurious as a too limited supply. Another point that has to be considered is that the digestion and the utilization of food by the body after absorption are dependent upon a number of different mechanisms, and when any of these are out of order the diet must be regulated to suit the condition, if trouble is to be avoided.

Definition of Dietetics. Allied Studies.—The science or study of the regulation of food, for normal or for abnormal conditions, is known as *dietetics.*

This study is naturally closely connected with that of the chemistry of food and with its cost, care, and cooking. Also, physiological chemistry or, as it is often called, *biological chemistry*, which includes the digestion, absorption, and metabolism of food material, is very intimately associated with, and a necessary preparatory study for, dietetics.

Classification of Food Material.—The various constituents of food are classified as organic and inorganic compounds.[1] The organic substances are classed as nitrogenous and non-nitrogenous.

The nitrogenous compounds are those which contain nitrogen: examples are the substance in the white of egg, known as albumin, which coagulates when it is heated; the curd that forms in milk when acid is added to it; the gummy substance, called gluten, contained in wheat.

The non-nitrogenous organic food substances, as their name implies, are those which do not contain nitrogen; they are the fats, organic acids, and

[1] The organic compounds are those containing carbon, with the exception of the salts known as carbonates, which, though they contain carbon, belong to the inorganic division of matter. The main reason for the divisioning of this classification is that, with the exception of a very few compounds, those containing carbon have certain similarities and are different in many ways from those without that element.

carbohydrates. The last include sugars, starches, gums, and allied compounds.

The inorganic matter of food is represented by its salts and water.

Elements of Which Food is Composed

Very few elements enter into the composition of food and the differences in the nature of the various kinds are due to different amounts of the elements and different arrangement of their atoms[1] in the molecules.[3] In many cases, the difference is due solely to the latter cause, *i. e.*, different arrangement of the atoms.

The carbohydrates, fats, and organic acids consist of carbon, hydrogen, and oxygen; the proteins, of nitrogen, carbon, hydrogen, oxygen, sulphur, and, sometimes, iron and phosphorus.

Water is composed of hydrogen and oxygen.

The chief salts or mineral constituents of food are salts of the elements calcium, sodium, potassium, magnesium, chlorin, sulphur, and phosphorus. Salts are formed from these elements because chlorin, sulphur, and phosphorus unite with hydrogen, or hydrogen and oxygen, to form acids, and these combine with the calcium, sodium, potassium, iron, and magnesium to form salts.

[1] An atom is the smallest particle of an element[2] that can exist and still maintain the chemic features of the element.

[2] A substance which cannot be divided into simpler forms of matter.

[3] A molecule is the smallest part of a compound that can exist and maintain its chemic characteristics.

The Sources of Food

The primary sources of food are the carbon dioxid (CO_2) of the air, water (H_2O), and the mineral matter of the soil. It is from these things that the substances of plants are formed and the animals used as food by man feed on plants or upon the flesh of animals that have done so. Thus animals owe their subsistence to plants; but the latter are dependent upon animals for their food, since the carbon dioxid of the air is derived from animal life, being formed (1) in the animal body, by the oxidation of the substances used as food, and given off in the respiration; (2) when organic matter (wood, coal, etc.) is burned; (3) as the result of fermentation and putrefaction of organic matter.

It is the leaves of the green plants that serve as factories for the manufacture of food; here, by the influence of the chlorophyl[1] and sunlight the CO_2[2] and H_2O[3] are made to undergo chemical reactions in which, it is thought, they interact to

[1] Chlorophyl is the green coloring matter of plants. It consists of carbon, hydrogen, oxygen, nitrogen, and magnesium. It does not itself contain iron, but seems to depend upon the presence of iron for its formation. It is related chemically to the hemoglobin of the red blood-cells, certain decomposition products of both substances being very similar.

[2] Chemical formula for carbon dioxid.

[3] Chemical formula for water. These formulæ show that a molecule of carbon dioxid consists of one atom of carbon and two of oxygen; and a molecule of water, of one atom of oxygen and two of hydrogen.

form simple compounds such as hydrogen peroxid (H_2O_2) and formaldehyd (CH_2O), and these in turn interact so that, by a gradual synthesis, the various simple carbohydrates are formed, during these processes, which are spoken of as *phosynthesis*,[1] heat is absorbed and oxygen given off to the atmosphere.

The oil or fat constituents of plants are made from the simple carbohydrates, many molecules of these uniting with a loss of some oxygen and carbon. The oxygen and carbon not used are given off from the plants as CO_2, especially during darkness, when photosynthetical processes are not going on. The carbohydrates also provide some of the material necessary for protein construction. The other constituents needed—nitrogen, sulphur, and, for some proteins, phosphorus and iron—are obtained from the soil in the form of salts, the plants absorbing them through their root-hairs, *i. e.*, the little hair-like processes projecting from the roots. These salts, as well as the carbohydrates used for building fats and proteins, are partially decomposed and their constituents then interact to form different and more complex substances. These decomposition and subsequent rebuilding processes are classed as *metastasis*[2] and are largely brought about by enzymes—*i. e.*, chemic sub-

[1] From the Greek, *photo* = light and *syn* = together and *thesis* = a putting.

[2] From the Greek *meta* = beyond and *histanai* = to place.

stances formed (those in plants) by the plant cells.

In addition to the salts containing the matter necessary for proteins, others, which constitute the mineral matter of plants, are absorbed by the roots, and it is through their roots that plants absorb the greater part of their water supply.

As previously stated, it is in the leaves that the principal synthetical processes occur; therefore, the matter absorbed by the roots must pass to the leaves, and the compounds formed in leaves must pass to those parts of plants which cannot build their own structural material; also, the starch, sugar, etc., is stored in different parts of plants, as the fruit, seeds, or roots. It is by means of the sap, which is constantly, especially in hot weather, passing slowly through plant substance; that this transference of material is accomplished.

The sap, which is to vegetable organisms what blood is to animals, is a solution of the various substances required and made in the plants, the water absorbed by the roots acting as the solvent.

The study of the nature of the forces which cause the movement of sap in plants belongs to physics and cannot be taken up here further than to say that two of the principal causes are (1) capillarity (*e. g.*, the rising of oil in a lamp wick, the wetting of all parts of a towel when only a small corner is in water), and (2) the avidity with which protoplasm absorbs water, which causes the upper and outer cells of a plant to take it

from those beneath them or behind them as they lose their moisture by evaporation or as it is used up in the chemical reactions.

Since plants take their building material from the soil, this must contain the substances that the plants to be grown in it need; therefore all plants cannot be grown in the same kind of soil and all soils must be constantly replenished with the material that plants remove from it. This is done by the use of fertilizers. One of the most commonly used fertilizers is manure, because this contains protein matter which, by the influence of certain bacteria present in the soil, is decomposed, giving rise to nitrates. Another method of obtaining nitrogen[1] for vegetation is to plant peas, or beans, or clover, or alfalfa; for the reason, that certain bacteria, which are able to take nitrogen from the air and combine it with other elements, attack the roots of these plants and, when this happens, little nodules or tubercles form on the roots surrounding the bacteria. The bacteria live and multiply in these nodules and produce nitrogenous substances some of which pass up into the plant and some into the ground.

[1] All forms of nitrogen, including that of the air, cannot be used either by plants or animals; thus, bacteria which cause the forms of decomposition of protein waste matter and other chemical reactions that give rise to nitrates, and bacteria which build nitrogen compounds in plants, are especially valuable to man.

CHAPTER II

CHARACTERISTICS, OCCURRENCE, AND FUNCTIONS OF ORGANIC FOODSTUFFS

The Carbohydrates

As the carbohydrates, especially the sugars, have the simplest chemical structure of the organic food materials, we will consider them first.

Classification and Composition.—The carbohydrates used as food are classed as:

(1) Monosaccharids (Gr. *mono*=one and Lat. *saccharum*= sugar), so called because they cannot be separated into simpler sugars.

(2) Disaccharids (Gr. *di*=double and Lat. *saccharum*=sugar), thus named because one molecule of any of the sugars so classed can be split by hydrolysis[1] into two molecules of a monosaccharid.

(3) Polysaccharids (Gr. *poly*=many and Lat. *saccharum*= sugar), so called because one molecule of any of the substances thus classed yield several molecules of monosaccharids.

The principal monosaccharids are:

Glucose or dextrose
Fructose or levulose
Galactose

[1] Chemic decomposition in which a compound breaks up after absorbing one or more molecules of water. The changes which occur in food during digestion are of this nature.

The disaccharids include:

Sucroses: cane sugar, beet sugar, maple sugar, palm sugar

Maltose or malt sugar

Lactose or sugar of milk

Mannite

The chief polysaccharid constituents of food are:

Cellulose
Starch
Dextrin
Glycogen
Inulin
Gums
Pectin

Glucose

$(C_6H_{12}O_6)$

Glucose, known also as dextrose,[1] grape sugar, starch sugar, and diabetic sugar, is found very widely distributed, especially in fruit, but also in some vegetables and other plants, and it is one of the main constituents of honey. It is usually associated with either or both levulose and a sucrose.

A large amount of the glucose sold is made by boiling starch with dilute acid. Glucose prepared in this way is much cheaper than the sucroses and is often used as a substitute for the latter in

[1] Latin *dexter* = right. Glucose was so called because it turns polarized light to the right.

making jams, jellies, candies, etc., though, being only a little more than half as sweet as sugar, it takes a larger amount.

There are two objections to the use of glucose for this purpose: (1) as it must be used in large quantities, in order to make the jam etc. as sweet as when a sucrose is used, the system, if much of the jam is eaten, becomes overloaded with glucose, which the kidneys must eliminate; also, that not immediately absorbed may undergo fermentation in the stomach with the production of irritating acids and gases. (2) Glucose prepared from starch in this way may contain sulphites, either as the result of the use of sulphuric acid for its manufacture or, if other acids are used, the use of sulphur dioxid as a bleaching agent; and sulphites, even though the quantity present may be very small, are not a desirable ingredient of food.

The sucroses, when boiled with acid, are converted into glucose, but they, being more expensive than starch, are not used as a source of glucose.

Glucose is formed in the animal body by the digestion of starch and disaccharids; it is absorbed by the blood, which, normally, contains about 0.1 to 0.2 per cent. How this percentage is maintained will be explained in the chapter on metabolism.

Glucose, in the presence of yeasts, readily undergoes fermentation and is thus converted into alcohol. This, if the fermentation process is not arrested, will be changed to acetic acid and this

to carbon dioxid and water—the substances, it will be remembered, from which the carbohydrates were made.

Glucose will also yield other substances than alcohol and acetic acid when acted upon by ferments other than yeasts, one common product being lactic acid. This acid can be formed by the simple splitting of the glucose molecule in half; thus the glucose molecule is $C_6H_{12}O_6$ and the lactic acid molecule is $C_3H_6O_3$.

Fructose

$(C_6H_{12}O_6)$

Fructose, known also as fruit sugar and levulose[1] is an isomer of glucose; that is, it contains the same elements in the same proportion, and the slight difference in the nature of the two sugars is due to some difference in the arrangement of the atoms in their molecules.

Levulose is found associated with glucose in fruits, some other plants, and honey. It can be prepared from glucose by treating the latter in a special manner with dilute alkalies, and it, with glucose, is formed in the animal body by the digestion of the sucroses.

Levulose is sweeter than glucose, having about the same degree of sweetness as cane sugar.

In many instances, levulose has seemed to be

[1] Latin *lævus* = left, so called because it turns polarized light to the left.

more easily utilized in the system in diabetes than glucose, and it is therefore sometimes used as a sweetening agent for the food of those suffering with this disease.

Galactose

$(C_6H_{12}O_6)$

This, like levulose, is an isomer of glucose. It is not found free in nature, but is produced as the result of the hydrolysis of lactose—the sugar of milk. Thus, it can be prepared by boiling lactose with acid, and it is one of the products of the digestion of lactose.

Solubility of the Monosaccharids.—The monosaccharids are all readily soluble in water and other liquids.

Sucroses

$(C_{12}H_{22}O_{11})$

Cane sugar, which is prepared from the sugar cane; beet sugar, prepared from beets; and maple sugar, obtained from the sap of the sugar maple, are the most used of the sucroses. Palm sugar, obtained from various species of palm, is much used in India and other Eastern countries. Sucroses resembling those obtained from the sugar cane and beets occur also in many fruits and other plants in combination with glucose and levulose.

Sucroses are hydrolyzed in digestion and by boiling, especially in the presence of acids, and

each molecule of a sucrose yields one molecule of glucose and one of levulose. It is for this reason that, as glucose is not as sweet as the sucroses, more sugar is required for hot lemonade than for cold, to obtain solutions of equal sweetness, and, also, that more sugar is required to sweeten cooked fruit if the sugar is added before the cooking is nearly completed.

Sugar in solid form or in concentrated solutions will be changed to caramel, a brown, slightly bitter substance, at a temperature of about 400° F.

Saturated sucroses are somewhat antiseptic, and cane and beet sugars are used for the preservation of fruit, but dilute solutions ferment readily.

Sucroses, as previously stated, are changed to glucose and levulose in digestion, but, if they are eaten in large quantities, some absorption of the unchanged sugar may occur; the body, however, does not seem to be able to utilize sugar in this state, for it is quickly eliminated by the kidneys. If so much sugar is eaten that the glucose into which it is changed cannot all be absorbed at the time, it is likely to be changed to lactic acid and gas and thus produce flatulence with eructation of acid.

Lactose

This occurs in the milk of all mammals and can be separated from the other constituents by evaporation and extraction.

It is made in the mammary glands from, it is thought, the glucose brought to the glands by the blood.

Lactose undergoes hydrolysis in digestion and if boiled with acid and is thereby changed to glucose and galactose.

Lactose is not as sweet as the sucroses and does not ferment as readily in the stomach as either these or glucose; it can be therefore taken in larger quantities at a time than these sugars, and thus it is used as a sweetening agent when it is advisable to increase the nutritive value of a food without increasing its bulk to any extent.

Maltose

Maltose or malt sugar is formed from starch by the action of diastatic enzymes (ferments which cause the hydrolysis of starch). Such enzymes are formed by the cells of certain plants, especially the cereals, and thus maltose is a common ingredient of (1) germinating cereals, (2) malt—this is prepared from barley—, and (3) malt products. It is formed also in the animal body in the course of the digestion of starch by the action of diastatic enzymes formed in the salivary glands and the pancreas. It is easily changed to glucose in digestion and by boiling it with acid and by the action of yeast.

Maltose is extracted from malted grains by the brewer in the making of beer, ale, etc. For

this purpose, it is, by the action of yeast, fermented and thus changed to glucose, which, in turn, is converted into alcohol and some of the alcohol is decomposed to carbon dioxid and water.

Mannite

This is a sweet sugar-like substance obtained from manna, which is procured from the juice of several trees, but, more especially, from a species of ash common in Sicily and other parts of Southern Europe. The chief use of mannite is as a laxative cathartic.

Polysaccharids

$$(C_6H_{10}O_5)n$$

An "n" or an "x" is placed after a chemical formula to show that the molecule of the substance designated is composed of a number of molecules containing the elements in the proportions specified. Thus the above formula shows that a molecule of any of the polysaccharids consists of a number of molecules each one of which contains $C_6H_{10}O_5$, which it will be noticed is the same as the glucose molecule minus one H_2O. The number of simple molecules in the compound molecules of the polysaccharids varies, there being, for example, far fewer in the dextrins than in starch and cellulose and, the simpler the dextrin, the fewer the simple molecules composing its molecule.

Cellulose

Cellulose is the substance of which the framework of plants is composed; thus, next to water, it is their most abundant constituent. It varies considerably in different plants and in the majority of plants at different stages of their growth. For example, the cellulose walls which hold the starch granules of the potato are less fibrous than those of the celery stalk and this is less hard than that of wood. The cellulose of young plants is usually more tender than that of older plants, the cell walls of most plants becoming thicker and tougher as they grow, due to the deposition of cellulose and loss of water.

Cellulose is insoluble in water, both hot and cold, dilute acids and alkalies, but it is hydrolyzed by strong acids and alkalies. Combined with nitric acid, it forms nitro-celluloses which are the bases for explosives, collodion and nitroglycerin.

Some of the lower animals apparently digest cellulose quite readily, but, though the more tender varieties are, to some extent, permeable to the digestive juices of the human alimentary tract, they are not readily digested, and whatever digestion does take place occurs in the intestine, largely as the result of bacterial action, and fatty acids seem to be the principal products yielded. Since a large portion of the cellulose is not digested, this substance has not a high nutritive value, for it is only after foods are digested and absorbed

that they can nourish the body or serve as a source of energy; nevertheless, a certain amount in the diet, except in the case of young children, is of great value as it serves as an intestinal irritant and promotes catharsis. A deficiency of cellulose in the diet is likely to be followed by constipation and the many ills attending this condition.

Starch

It is thought that, in the plant, starch is formed from the simple sugars by a process the opposite of hydrolysis, viz., dehydration or the putting together of molecules with a loss of water.

Starch is stored chiefly in the roots, seeds, fruit, and stems of plants.

Though starch is contained in varying amounts in a large number of plants, only corn, wheat, potatoes, rice, cassava, and arrowroot serve as common sources for the starch of commerce.

The unchanged granules of the starches from different plants vary in size and shape, and by inspection under a microscope one starch can be distinguished from another. This is, therefore, a valuable means of detecting the adulteration of the more expensive starches with cheaper ones, a common form of adulteration.

The flavor of the different starches is not quite the same and that of those of cereal source—corn, wheat, rice—is improved by comparatively long cooking, but this is not the case with starch of

tapioca and sago. Food in which the starch is still enclosed in its cellulose encasement requires long cooking in order to soften and rupture the cellulose.

Starch is insoluble in water, but, except in the case of wilted or dried foods, which have lost their natural water, starch is extracted from starch-containing foods if they are left standing in water for any length of time. If water containing starch is heated, the starch will absorb it and swell and gradually form the jelly-like material known as *starch-paste*. Heat converts starch into a substance known as *dextrin* that is soluble in water; the brown of toast is an example. If heated in an acid solution, or subjected to the action of yeast, and in digestion, starch is changed to glucose.

When dry, starch will keep indefinitely in a good condition, but if it becomes at all moist, it is easily fermented by yeasts and other organisms which produce fermentation.

Dextrins

Dextrins are only occasionally found in uncooked foods. They are formed from starch when the latter is boiled, when it is heated to about 200° C.—the crust of bread is an example—, and in digestion. Dextrins, unlike starch, are soluble in water.

In the process of hydrolysis, dextrin undergoes

a gradual change in which the size of its molecule is reduced, and, based upon the way in which the products of the different stages react to iodin,[1] they have been named amylodextrin,[2] erythrodextrin 1,[3] erythrodextrin 2, erythrodextrin 3, and achrodextrin.[4] The hydrolysis of achrodextrin gives maltose and this yields glucose.

Maltodextrin, which is thought to be a combination of maltose and dextrin, is formed from starch in germinating cereals by the action of the diastatic enzyme produced in the grain. It is very rapidly hydrolyzed by ferments to maltose and by acids to glucose.

Since dextrins represent partially digested starch, rusks, zwieback, and thoroughly toasted bread are easily digested articles of diet.

Dextrin is often used instead of gum as a base for pastes and mucilage.

Glycogen

Glycogen, known also as animal starch, is a white powder that is soluble in water. It is

[1] The common test to detect starch in matter is to add a little iodin to the material. The iodin combines with the starch to form an iodid of starch which is blue. If it is amylodextrin that is present, the substance becomes a deeper blue; if it is erythrodextrin 1, the substance becomes purple; erythrodextrin 2 gives a red color with irodin; erythrodextrin 3, a red-brown color; achrodextrin takes the color from the iodin.

[2] Latin *amylum* = starch.

[3] Greek *erythros* = red.

[4] Greek *achromatos* = colorless.

extracted from liver. It is formed in the animal body, in the liver, from the glucose that comes through the portal vein from the intestine, and it is stored in the liver and, to some extent, in the muscles.

After the death of an animal, the glycogen in the muscles is rapidly decomposed so that it is not found in other meats than liver, but oysters and shellfish may contain as much as 9 per cent.

Glycogen is found also in fungi and other plants devoid of chlorophyl.

Inulin

Inulin is a starch-like substance that is found dissolved in certain plants, especially the Jerusalem artichoke.

Gums

These are viscid substances contained in many plants and in the wood and bark of several trees. They have the same chemical composition as the other polysaccharids.

Pectins

The pectin substances are other important polysaccharids. They are formed in certain plants from pectose which, it is thought, is produced by the combination of several molecules of the simpler carbohydrates. They are contained in nearly all fruits, both in the juice and marc

(the insoluble portion of fruit), and in some vegetables. Those of different plants vary considerably in character.

In the presence of organic acids and sugar, many of the pectins will, especially if heated and then cooled, cause the juices containing them to form the substance known as *jelly*. However, due to some characteristic of the pectin bodies, or to deficiency of pectin or of fruit acid, all juices containing pectin bodies will not jelly.

The juice of some raw fruits will jelly if heated with sugar, notably currants and blackberries, but it is necessary to cook the majority of fruits in order to extract their pectin into the juice, and all fruit juices are richer in pectin if the fruit is cooked for at least a short time before the juice is strained off.

Slightly unripe fruit will contain more pectin than ripe, but the flavor of unripe fruit is not as well developed; thus, in making fruit jellies it is customary to combine the two.

By boiling, pectin is converted into simple sugars; therefore, in making jelly the cooking must not be continued too long.

Function of the Carbohydrates

Carbohydrates, after absorption, are used as a source of heat and energy. If more carbohydrate food is eaten than is required for this purpose, or than can be stored as glycogen, the excess will be converted into fat.

Fats and Fixed Oils

Animal and vegetable fixed oils[1] are compounds of simple fats, and these are *glycerin esters* of fatty acids.

An ester is a compound formed by the condensation of an alcohol with an acid and is analogous to a salt.

Glycerin is known in chemistry as a triatomic alcohol, because its chemical structure is that of an alcohol with three OH radicals,[2] with which it will part in chemical reactions,[3] and when it interacts with fatty acids, which are monatomic —*i. e.*, having but one replaceable H (hydrogen) atom,—it does so in the proportion of one atom of glycerin to three atoms of fatty acid.

The most common fatty acids are stearic, oleic, and palmitic. The simple fat formed by the interaction of stearic acid and glycerin is known as *stearin;* that formed from oleic acid is known as *olein;* that from palmitic acid as *palmitin.*

[1] The term *fixed oil* is used for those oils which are not volatilizable at ordinary temperatures. If a fixed oil is spilled on paper it will leave a translucent spot (this is one of the tests for the presence of fats in a liquid), but a volatile oil will volatilize and thus disappear.

[2] A radical is a group of two or more elements that acts as one atom in a chemical reaction.

[3] When a base or alcohol interacts with an acid to form a salt or ester, the base or alcohol loses its OH radical and the acid its H, and the OH and H unite to form water (H_2O). The substance formed by the remainder of the molecule is the salt or, in the case of an alcohol, ester.

Stearin is solid at ordinary temperatures, palmitin is semi-solid, and olein liquid; therefore, the larger the proportion of stearin in a compound fat, the firmer it will be and the higher the temperature at which it will melt.

These simple fats are contained, in varying proportions, in all animal fats. There is little or no stearin, however, in vegetable oils, but palmitin and olein, especially the latter, are contained in many of them as well as other simple fats. Butyrin is a simple fat contained in cream and butter; it is an ester of glycerin and butyric acid.

Fixed oils and fats are essentially the same, the main difference being in their physical state (*i. e.* solid or liquid) at ordinary temperatures, and the two substances act in the same way in chemical and physical processes.

In different parts of many plants there are also substances known as *volatile oils*, but these have little in common with the fixed oils and will be considered with the condiments and flavoring extracts.

Emulsification and Saponification.—Oils and melted fats can be emulsified, *i. e.*, separated into droplets, by mechanical action—*e. g.*, churning, but such emulsification is permanent only if the droplets are surrounded by a film of protein (as in milk) or by some viscid substance. Oils and fats are also emulsified by mixing with an alkali; the alkali, causing the separation of part of the oil into its constituent parts (glycerin and

fatty acids), combines with the fatty acids to form a soluble soap and by the process sets up diffusion currents which break the remaining oil globules into droplets.

The fat of the diet is emulsified in this way in the small intestine as a preliminary to its complete saponification.

Fats are hydrolyzed by boiling with acids or alkalies, by superheated steam, and by the action of enzymes. The hydrolysis of fats implies their splitting into fatty acids and glycerin. If the hydrolyzing elements are heat and an alkali or, as in the intestine, an enzyme in the presence of alkalies, the alkali unites with the freed fatty acid to form soap.

Saponification can be brought about also by churning oil and an alkaline solution together. This is one method of making what are known as *cold process soaps.*

Solubility of Fat.—Fats are insoluble in cold water, slightly soluble in boiling water, freely soluble in alkaline solutions, hot alcohol, ether, benzene, and similar substances.

Uses in the Body.—Fats, after absorption, are oxidized, thereby yielding heat and energy, and that not so used is converted into fatty tissue.

Lecithin

This is a soft, waxy, fat-like substance that is soluble in chloroform, benzene, oil, and alcohol.

It absorbs water, and in doing so swells and assumes what is known as a *myelin form*. When in this condition, lecithin is permeable to substances which otherwise cannot pass through it or can do so only with difficulty.

Lecithin is often spoken of as a *phosphorized fat* and as a *nitrogenous fat*, because it is a compound of glycero-phosphoric acid with fatty acids and a nitrogenous substance, usually that known as *cholin*.

Lecithin and some similar substances are normal constituents of cells. They are especially abundant in brain and nerve tissue and in yolk of egg. Lecithin is found also in the bile, that liberated from cells in metabolism being excreted in this way.

The function of lecithin and its compounds in the body is not clearly understood, but their physical and chemical properties and the differences of permeability under different conditions tend to lead to the belief that they are of importance in regulating the permeability of cells and that they have important functions of a chemical nature in cell nutrition.

Cholesterin

This is a form of alcohol that is present in nearly all the fluids and tissues of the body, especially in the central nervous system. It is contained also in comparatively large amounts in yolk of egg.

Proteins

These are essential constituents of all plant and animal tissue, and are indispensable to life.

Composition of Proteins.—The structure of the protein molecule is very complex and is as yet but imperfectly understood. Though only a few elements enter into the composition of proteins—nitrogen, carbon, hydrogen, oxygen, sulphur, and, sometimes, phosphorus and iron—many of the proteins contain thousands of atoms of these elements in differing combinations and proportions.

The non-mineral elements of protein molecules—nitrogen, hydrogen, carbon, and oxygen—are so combined that they form what are known as *anhydrids of amino acids* or *peptids.*

By the **anhydrid** of an acid is meant a substance formed from an acid by the loss from its molecule of a molecule of water.

Amino acids differ from other organic acids in that in lieu of the replaceable hydrogen atom or atoms,[1] characteristic of acids, they have what is known as an amino group or radical which is NH_2. For example, acetic acid is represented by the formula CH_3CO_2H, and amino acid by the formula $CH_3CO_2NH_2$. Amine is somewhat similar to ammonia—NH_3—and, by union with hydrogen,

[1] All acids have a hydrogen atom or atoms which they part with when they interact with alkalies, etc., to form salts. This hydrogen is spoken of as *replaceable* because it is replaced by a portion of the substance with which the acid interacts.

is converted into ammonia during the decomposition of protein-containing matter.

There are a large number of different amino-acids, some of which, it has been found by hydrolyzing proteins and separating the products of hydrolysis, are present, though in very different amounts, in the molecules of nearly all protein substances. Some proteins, however, do not contain certain amino acids that are very important in tissue building and for other purposes, as will be seen later, and these, experiments seem to show, have not such a high nutritive value as those which contain them.

Classification of Proteins.—The proteins have been classified according to their physical properties, especially their solubility in pure water, weak salt solutions, and dilute acids and alkalies. This classification is as follows:

Simple Proteins	Conjugated Proteins
Albumins	Nucleoproteins
Globulins	Glucoproteins
Glutelins	Phosphoproteins
Alcohol-soluble proteins	Hemoglobins
Albuminoids	Lecithoproteins
Histones	
Protamines	

Derived Proteins

Primary Protein Derivatives	*Secondary Protein Derivatives*
Proteans	Proteoses
Metaproteins	Peptones
Coagulated proteins	Peptids or amino acids

Simple Proteins

Simple proteins are those which, when digested or otherwise hydrolyzed, yield only amino acids or their derivatives. They were called *simple* because they yield only one class of products, but their molecules are the most complex of any of the foodstuffs except the conjugated proteins.

Albumins are simple proteins that are soluble in pure water, concentrated sodium chlorid solutions, dilute salt solutions, dilute acids, and dilute alkaline solutions. **Globulins** are soluble in the three last named substances, but not in pure water nor concentrated salt solution. The molecules of both these proteins tend to aggregate together in the form of a coagulum under the influence of heat and certain salts, such as bichlorid of mercury, silver nitrate, etc.

Albumins and globulins are generally found together in nature both in animal and vegetable foods, but, as a rule, there are more albumins than globulins in animal fluids, as blood, and more globulins in animal tissues and in plants.

The several different kinds of albumins and globulins are given different names; thus albumin in serous fluids and in blood is called serum-albumin; that in eggs, ove-albumin; that in milk, lact-albumin; that in muscle tissue, myogen. The globulins of the blood are called serum-globulin or paraglobulin and fibrinogen; that in muscle tissue, myosin; also there are a few albu-

mins and various globulins in plants but, as their special names are not in common use, they need not be given here.

Glutelins are simple proteins that are insoluble in all neutral solvents—*i. e.*, those neither acid nor alkaline—but easily soluble in dilute acids and alkalies. Glutenin of the gluten of wheat is the most common example of this group.

Alcohol-soluble proteins are simple proteins that are soluble in relatively strong alcohol (70–80 per cent.), but are insoluble in water, absolute alcohol, and neutral solvents. Gliadin is the best known of this class of proteins; it occurs in connection with glutenin in some of the cereals, especially in the gluten of wheat.

Albuminoids are simple proteins which are characterized by great insolubility in cold neutral solvents. Examples of this group are ossein of bone; collagen of tendons and its hydration product gelatin; elastin of ligament; keratin of nails, hoofs, hair, horns, and feathers. By looking at the table on page 37 it will be seen that gelatin lacks some of the amino acids present in the majority of other proteins, and at least two of these, tyrosine and tryptophane, have been shown by feeding experiments on animals to be necessary for the maintenance of life. Thus gelatin cannot be used as a substitute for albumins and globulins.

Histones and protamines are simple proteins of less complex structure than those previously mentioned. They are not very common. The

best known histone is the globin of hemoglobin, and both histones and protamines have been isolated from the spermatozoa of certain fish. Both histones and protamines are soluble in water; they are precipitated by other proteins and have basic characteristics, *i. e.*, they form salts in combination with acids. Protamines are not coagulated by heat; histones are, but the coagulum is very easily dissolved by dilute acids.

Conjugated Proteins

Conjugated proteins are those which contain the protein molecule united to some other molecule or molecules otherwise than as a salt.

Nucleoproteins are compounds of proteins and nucleic acid. The nucleoproteins, as their name implies, are the proteins of the nuclei of cells. They are, therefore, found in largest amounts in parts where cellular tissue is abundant and the cells are highly nucleated, as in glandular tissues and organs. During digestion, or by hydrolysis brought about outside the body, a nucleoprotein is decomposed into protein and nucleic acid. On further decomposition, nucleic acid yields: (1) what are known as the *purin base*—*e. g.*, xanthin, hypoxanthin, adenin, and guanin—which, in metabolism, are oxidized, thus forming uric acid; (2) various substances classed as *pyrimidine bases;* (3) a carbohydrate group; (4) phosphoric acid.

Glucoproteins are compounds of protein and a

substance or substances other than nucleic acid, containing a carbohydrate molecule. Particularly rich in glucoproteins are the secretions of the mucous membranes.

Phosphoproteins are compounds of the protein molecule with a phosphorus containing group other than lecithin or nucleic acid. The caseinogen of milk and vitellin of egg yolk are examples.

Hemoglobins are compounds of the protein molecule with hematin or some similar substance. The coloring matter of blood is the best known compound of this type. This acts as the oxygen carrier for the body, and this, its important function, is dependent upon the iron which it holds in organic combination.

Lecithoproteins are compounds of the protein molecule with lecithins. Lecithins, as already stated, are compounds of glycerol, phosphoric acid, fatty acids, and a nitrogenous base such as cholin. The lecithoproteins are essential cell constituents.

Derived Proteins

These substances are derived from the more complex proteins by the action of the digestive juices and by boiling with acids or alkalies. The **primary derivatives** are those which have not undergone any very great change from their original form; **secondary derivatives** are those in which the changes have been carried to greater

degrees. The **proteoses, peptones,** and **peptids** are especially characterized by greater solubility and by their power to diffuse through animal membrane, such as that of the intestinal wall. The peptids consist of combinations of two or more amino acids. They are designated as *dipeptids*, *tripeptids*, *polypeptids*, etc. (*di* signifying two, and *tri*, three, and *poly*, many), when it is wanted to show how many amino acids are combined.

Non-Protein Nitrogenous Substances.—There are in both plant and animal tissues certain nitrogen containing compounds of simpler structure than the amino acids. Examples of these are the amids of plants and the extractives of animal tissues.

The amids are believed to be the form in which nitrogen compounds are transferred from one part of the plant to another. The so-called *extractives of meat* are substances formed in the animal body in the course of metabolism. Similar substances are found also in plants, *e. g.*, caffein of coffee berries and tea leaves is similar in chemical construction to xanthin, one of the purin bases which, it will be remembered, are decomposition products of the nucleoproteins and are among the substances commonly spoken of as *meat extractives.*

Uses of Protein Substances.—As will be seen in the chapter on metabolism, part of the protein of food is oxidized; thus it serves as a source of

heat and energy, but its special function is to provide building and repair material for the proteins of the body. All proteins, however, are not equally valuable for this purpose. As the result of feeding animals with proteins deficient in certain amino acids, it has been concluded that at least a number of different acids serve special purposes and that therefore foods containing them are essential. For example, animals given food in which the amino acid known as *lysin* was lacking failed to grow, though they did not seem to be otherwise particularly affected; thus it is thought that lysin is essential for growth, though not for mere maintenance, while the amino acid known as *tryptophane* is essential for the formation of some substance, perhaps adrenalin or similar material, which is necessary to life.

In the book entitled *The Physiology of the Amino Acids*[1] the author states: "Investigation into biochemical deportment of the protein cleavage products will undoubtedly lead ultimately to the assignment of more or less specific functions to the various amino acids and, hence, will indirectly indicate the relative efficiency of this or that protein in bringing about the desired result in nutrition."

"The body of an average man weighing about 156 pounds contains about thirty pounds of protein or 20 per cent. of the live weight. If the

[1] *The Physiology of the Amino Acids*, Frank P. Underhill, Ph.D., Yale University Press, p. 158.

man starves, he will lose five parts per thousand of his store daily. If he be given fat and carbohydrates in large quantity, the daily loss of body protein may be reduced to 2.5 parts per thousand. This loss of body protein represents the irreducible minimum of wear and tear on the constituent parts of the machinery of the cells."[1] If he take meat or other protein food containing the same amino acids in sufficient quantity to equal the minimum amount of protein destroyed there will be no loss of body protein, since that broken down will be replaced by the food protein.

The proportions of amino acids in animal flesh, milk, and eggs more nearly resemble those of the human body, and thus it will take a smaller amount of these foods to prevent loss of body protein than it will of vegetable protein. As the result of experiments by different people, it has been found that the following amounts of different proteins are required to protect body protein from loss[1]:

Meat protein	30	grams
Milk protein	31	"
Rice protein	34	"
Potato protein	38	"
Bean protein	54	"
Bread protein	76	"
Indian corn protein	102	"

Thus it can be seen that vegetable protein has not quite the same nutritive value as most of that

[1] *The Fundamental Basis of Nutrition*, Graham Lusk, Yale University Press, pp. 19 and 20.

of animal source, since it takes a larger amount of it to supply a sufficient quantity of all the required amino acids. Gelatin, owing to its not containing tyrosin, cystin, and tryptophane, has not, like other animal proteins, all the matter needed for cell repair nor the maintenance of life.

TABLE SHOWING THE QUANTITIES OF AMINO ACIDS OBTAINED FROM SOME SIMPLE PROTEINS, BEEF AND HALIBUT, BY HYDROLYSIS[1]

AMINO ACIDS	*Albumin egg*	*Albumin serum*	*Casein milk*	*Glutelin wheat*	*Gliadin wheat*	*Legumin pea*	*Beef*	*Halibut*	*Gelatin*
Glycocoll	0.00	0.00	0.00	0.51	0.02	0.38	2.06	0.00	16.5
Alanine	2.22	2.7	1.50	1.40	2.00	2.08	3.72	0.00	0.8
Valine	2.50	....	7.20	0.16	0.21	?	0.81	0.79	1.0
Leucine	10.71	20.0	9.35	4.45	5.61	8.00	11.65	10.33	2.1
Proline	3.56	1.0	6.70	2.44	7.06	3.22	5.82	3.17	5.2
Oxyproline	?	....	0.23	0.00	0.00	?	0.00	0.00	3.0
Phenylalanine	5.07	3.1	3.20	2.53	2.35	3.75	3.15	3.04	0.4
Glutaminic Acid	9.10	7.7	15.55	23.14	37.33	13.80	15.49	10.13	0.9
Aspartic Acid	2.20	3.1	1.39	5.42	0.58	5.30	4.51	2.73	0.6
Serine	?	0.6	0.50	0.00	0.13	0.53	0.00	0.00	0.4
Tyrosine	1.77	2.1	4.50	1.12	1.20	1.55	2.20	2.39	0.
Cystine	?	2.5	?	0.00	0.45	?	0.00	0.00	0.00
Histidine	1.71	....	2.50	1.58	0.61	2.42	1.76	2.55	0.4
Arginine	4.91	....	3.81	11.85	3.16	10.12	7.47	6.34	7.6
Lysine	3.76	....	5.95	0.70	0.00	4.29	7.59	7.45	2.8
Tryptophane	*present*	*present*	1.50	*present*	*present*	*present*	*present*	*present*	0.00
Ammonia	1.34	....	1.61	3.70	5.11	1.99	1.07	1.33	0.4
Total	48.85	....	65.49	59.00	68.82	57.43	67.30	50.25	42.1

[1] Compiled from different sources.

Uses of Non-Protein Nitrogenous Substances.—While the cells of the human body have the power

to synthesize amino acids to form the more complex structures of their own protoplasm, they do not seem to be able to transform one amino acid to another, nor to synthesize the simple nitrogenous products of protein decomposition such as ammonia and the various ones present in animal tissues that are commonly spoken of as *meat extractives*. Thus these substances cannot serve for tissue building nor, as they are about as fully oxidized as they ever become in the body, do they furnish material for heat and energy, since it is by their union with oxygen that foodstuffs become a source of heat, just as coal is only a source of heat when it is burning, *i. e.*, uniting with oxygen. Nevertheless, these substances are of value in the diet as the flavor of meat is due to them. Their action and use are comparable to those of the condiments. See page 170.

Organic Acids

The majority of organic acids connected with food are found in fruit, either free or in the form of salts. The principal organic acids are:

(1) **Citric acid** and **citrates** (its salts), which occur in large quantities in lemons, oranges, grapes, limes, and, in smaller quantities, in quinces, gooseberries, currants, raspberries, strawberries, and cranberries.

(2) **Malic acid** and **malates** (salts of malic acid), which occur in apples, pears, currants, blackberries, quince, pineapple, cherries, and rhubarb.

(3) **Tartaric acid,** which occurs in grapes.

Acetic acid, another important organic acid, is obtained by the fermentation of carbohydrates. It is not present in good fruits but is developed in them during decay by the fermentation of their sugar. Vinegar contains about 6 per cent. acetic acid. The salts of acetic acid are known as *acetates*.

If there is gastric hyperacidity these acids may increase the condition, but, in the intestine, they unite with alkaline substances there present and are thus changed to salts. As these are not readily absorbed they act as laxatives. The portion absorbed is changed in the blood to carbonates and thus these acids, serve as systemic alkalinizers. They especially citric acid, are thought, if taken in large amounts, to lessen the viscosity of the blood by slight change in the physical properties of some of its colloidal constituents.

Lactic acid is formed in milk by the fermentation of its milk sugar under the influence of lactic acid bacteria. On the theory that the growth and action of the bacteria which cause putrefaction in the intestine are inhibited by lactic acid germs and their products, lactic acid drinks, such as buttermilk, fermillac, kumyss, sour milk, and zoolak, have come into extensive use, and special strains of lactic acid bacteria are sold in capsules, liquids, and tablets to be used for souring milk and to be swallowed. Whether intestinal putrefaction is thus prevented is still doubtful, but, if taken in

large quantities, these drinks are likely to produce gastric hyperacidity and to increase systemic conditions due to acid accumulation, if such exist.

CHAPTER III

OCCURRENCE, USES, AND REQUIREMENTS OF INORGANIC FOOD CONSTITUENTS. ACCESSORY FOODSTUFFS

Mineral Matter

THE mineral matter of food and of the human body is known also as *salt* and as *ash*. It is called salt because the greater part of the mineral matter is present in the body, and is practically all excreted, in the form of salts. The second term is used because the mineral matter, being incombustible, constitutes the greater part of the ash when food is burned.

Some of the mineral constituents of the body, however, especially iron, sulphur, and phosphorus, are present in combination with organic matter, and various experiments have shown that the material required for some of these substances must be taken into the body as constituents of organic matter; for the animal body, unlike plants, does not seem to be able to form these compounds to any extent from inorganic combinations.

The principal mineral constituents of the body are: The chlorids, phosphates, and carbonates of

potassium, sodium, calcium, and magnesium, and, in combination with organic matter, iron, phosphorus, and sulphur.

Uses of Mineral Matter.—Mineral matter, being incombustible, cannot be used in the body as a source of heat; nevertheless, much of it is quite as essential to life as the fuel foods. Some of the principal uses, sources, and combinations of the various mineral substances are as follows:

Iron.—Normally, the human adult body contains about 40 to 55 grains of iron (2.40–3.40 gm.). That taken in food or as medicine by mouth is absorbed from the intestine and is deposited primarily mainly in the bone marrow, liver, and spleen. The greater part of this is taken by the hemoglobin of the red blood-cells and most of the remainder is needed for the chromatin substances of the cells.

Iron is necessary for the formation of hemoglobin and for its functioning; which is, absorbing oxygen in the lungs and transferring it to the tissues. The amount of hemoglobin in the red corpuscles will determine the amount of oxygen that will be absorbed and deficiency of iron will entail a low per cent. of hemoglobin, since iron is necessary for its formation. Iron is also of importance for the oxidative processes occurring in the tissues and for the activity of specialized cells such as those of the secretory glands.

Iron is being constantly set free as the result of the normal disintegration of cells and, under

certain conditions, as during diseases, especially those due to bacteria, there is usually an excessive destruction of the red blood-cells, and elimination of iron through the intestinal wall. As the body supply of iron is so small, it is most important that both normal and abnormal loss be made good at once, about on an average fourteen milligrams a day being required by an adult in normal condition. This is one of the minerals that is likely not to be provided in sufficient quantity, for many much used foodstuffs are quite lacking in iron: viz., meat fats, salad oils, bacon, starches, sugars and consequently candies and syrups.

The foods containing the largest amounts of iron are: egg yolk, lean beef, cereals, lettuce, cabbage and spinach, asparagus, celery, radishes, beans, peas, grapes, and raisins.

The quantity of iron in milk is not as large as in the above foods, but it seems to be in a combination that renders it particularly easily absorbed and utilized by the body. Milk and eggs would naturally be the foods to contain iron and other substances necessary for growth and nutrition in the largest amounts, or the most assimilable form, since the egg must hold all the material necessary for the development of the chick, and milk is the food of young mammalia during the most active stage of their growth.

Beef contains a relatively large amount of iron, because of the blood retained in the tissues, but as the iron is in combination with the hema-

tin of hemoglobin, which is very imperfectly absorbed, meat will not furnish the body with the same amount of iron as milk and eggs will and, probably, it will not provide as much as fruit and many vegetables.

The amount of iron that will be obtained from cereal foods depends upon the degree to which the germ and the outer layers of the grain are removed in their preparation for the market, as it is chiefly in these parts that the iron is contained in combination with protein.

Uses of Inorganic Iron.—Many experiments have been performed to ascertain if inorganic iron, such as is contained in water or as is used medicinally, could be utilized to replace food iron for the formation of hemoglobin,[1] but animals who were given iron-free foods mixed with inorganic iron soon died, and, on account of this and other results obtained, the conclusions were drawn that inorganic iron could not be used as a substitute for food iron, but that, when the amount of iron in the body is below normal, inorganic iron acts as a stimulus to the blood-forming organs, thereby accelerating the synthesis of hemoglobin. However, when the use of inorganic iron is necessary, foods containing the largest and most assimilable forms of iron should be used as freely as possible.

[1] A description of some of these experiments will be found in *Experiment Stations Bulletin 185; in Chemistry of Food and Nutrition*, Sherman, The Macmillan Company; *Text-Book of Physiology*, Howell, Saunders & Co.

Phosphorus.—Phosphorus exists in the body in at least three forms: (1) In combination with protein; (2) in combination with fat; (3) as inorganic salts. These are also found in different foods and, in addition, in some plants, especially the legumes—peas, beans, lentils, peanuts—and cereals, there are some simple organic phosphorus salts that have been classed as **phyates** or **phytin.**

The principal phosphoprotein combinations in the body are found in the nucleoproteins of cell nuclei and the lecithoproteins. Important food sources of phosphorized proteins are the caseinogen of milk and the vitellin of egg.

The lecithins are the principal phosphorized fats.

In the body, the chief inorganic salts of phosphoric acid (which is a derivative of phosphorus), are potassium and calcium phosphates. The former are most abundant in the soft tissues and liquids and calcium phosphate in the bones, of which it constitutes the chief mineral matter. These phosphates are found in varying amounts in water, milk, eggs, meat, fish, fruit, vegetables, and cereals. How far they can be used in the body for the synthesis of its necessary organic phosphorus compounds is not known, It is thought, as the result of various experiments, that they can be utilized for the purpose to a certain extent, but not nearly sufficiently to use them as substitutes. They are, however, very necessary to help in neutralizing acids which are

formed in metabolism and for the bones. Naturally, they are especially needed for the latter purpose during the years of growth, but, even in later life, they are required to replace that catabolized, for, though the bones are probably not catabolized as rapidly as the softer tissues, metabolic changes certainly occur in them and part of the phosphates eliminated are derived from this source.

The phyates are contained more especially in the vegetables classed as legumes and in cereals from which all the germ and outer layers have not been removed. Phyates are readily extracted during digestion from the other compounds with which they are combined; also they are easily absorbed and, it is thought, they are a valuable form of phosphorus for the synthesis, by the body, of its more complex organic phosphorus compounds.

Organic, as well as inorganic, phosphorus compounds not used, or set free in metabolism, are excreted, chiefly by the kidneys, but also through the intestinal wall, as inorganic phosphates.

Judging from the amount of phosphates excreted, it is thought that at least 1.2 grams of phosphates are required per day. This is equivalent to 2.75 grams of phosphorus pentoxid or, as it is commonly called, phosphoric anhydrid (P_2O_5), which is the form in which the phosphorus content of food is generally computed.

Calcium.—Ninety-nine per cent. of the calcium of the body is contained in the bones, principally

in the form of calcium phosphate. It serves to give the bones the rigidity which enables them to maintain their shape. The remainder of the calcium is present in the blood and other fluids, in the form of soluble salts, and in the tissues in both organic and inorganic combinations. Calcium salts are necessary for the clotting of blood and a deficiency of these salts in the blood will permit of severe hemorrhage from even a slight wound. Also, calcium salts, with those of potassium and sodium are essential for the heart action. The sodium and potassium salts, when calcium is present, induce irritability and contraction of the heart muscle, but, if there is no calcium, they promote relaxation; calcium has the opposite effect and, therefore, when these salts are present in the proportions in which they naturally exist in the blood, they induce the alternate contraction and relaxation of the heart. Other muscle tissue also is probably influenced by the presence of these salts.

Naturally, calcium is especially required by growing children and by women during pregnancy and lactation; for a woman must then furnish the lime required by the fetus or infant. The bones of infants and children who do not get sufficient calcium will not harden properly and will thus bend easily, as in the disease known as *rickets*. A lack of calcium salts may not be obvious in other ways for a long time, because the blood takes lime from the bones when it is not

furnished in sufficient quantity in the food. The deterioration of women's teeth that sometimes occurs during pregnancy and lactation is thought to be due to the abstraction of lime as the result of failure to supply the extra amount required at this time.

In old age and in some forms of arthritis and arteriosclerosis, it is often necessary to limit the supply of calcium.

Of foods, milk is the most valuable as a source of calcium; nuts, oatmeal, rice, egg yolk, and green vegetables come next, and then other vegetables and cereals, but the amount in these is far below that in milk. Hard water usually contains a moderate quantity and thus may be of some use in supplying a deficiency

Foods poor in lime are: meat—except that from young animals, as veal—fish, white breads, fruit, and potatoes.

Sodium, Potassium, and Chlorids.—Sodium occurs in the body chiefly in the form of chlorids. It is contained principally in the blood, lymph, and other fluids and only to a slight extent in the solid tissues. Potassium, largely in the form of phosphates, is present chiefly in the soft tissues, glandular organs, and some special secretions, as the milk.

The principal functions of these salts in the body are: (1) The neutralization of acids formed during metabolism, as well as those taken in food. (2) The maintenance of the heart action, as

described under calcium. (3) The maintenance of normal osmotic pressure. All the salts are concerned in this, but the sodium salts seem to play the most important part. (4) Sodium chlorid is decomposed by certain gastric glands and its chlorin used for the manufacture of hydrochloric acid, one of the essential constituents of the gastric juice. Its uses will be described in the section on digestion.

Since potassium is present in nearly all animal and vegetable foods, there is not much risk of a deficiency, if the general supply of food is sufficient, and, as sodium chlorid is used so freely as a condiment, there is more often an excess than a deficiency of supply. The use of sodium chlorid will be further discussed in the section on condiments.

Sulphur.—A small quantity of sulphates are taken into the body with water and food, but the essential sulphur is in combination with protein. It is one of the constituents of all protein substances.

Water

Water forms quite a large per cent. of the majority of foods, as can be seen by the table in Chapter XII, but, as its loss from the body in the urine, sweat, feces, and from the lungs is great (about 4½ pints per day), it requires a greater amount than can be supplied by solid food to meet the body requirements. Thus it must be taken either

alone or in the form of soups, broths, or beverages, as milk, tea, cocoa, alcoholic beverages, etc.

The amount of water necessary to take in actually liquid form to replace the daily loss is, under ordinary circumstances, about 2½ to 3 pints. The amount of water loss, however, is often increased by such causes as excessive perspiration or urination, vomiting, diarrhea, loss of blood, the taking of saline cathartics or salty foods, which, since they contain a larger per cent. of salts than the blood (*i. e.*, are hypertonic), cause the osmosis of fluid from the blood and tissues of the intestinal walls into the intestine. When the loss of water is increased, the supply, likewise, must, usually, be larger, unless the loss has been brought about purposely, as by the use of diuretics, in order to rid the body of accumulated fluid, such as is present in edema.

The uses of water in the system which render it so important are:

(1) It is an essential constituent of all protoplasm.

(2) It constitutes the bulk of the blood and other liquids of the body, and lessening of its amount in the body reduces, temporarily, the pressure in the blood-vessels, which interferes with the heart action, the circulation, and the excretion of urine. Diminution of the water content of the blood results in the extraction of fluid from the tissues, for, as soon as the blood becomes unusually concentrated there will be

an increased osmosis of fluid from the tissues into the blood-vessels.

(3) Water is essential for the chemical reactions that occur in digestion and metabolism, and it aids digestion by acting as a solvent for the food, and hot water does so also by stimulating the motor action of the stomach.

(4) Water is necessary for the removal of waste from the tissues and insufficiency of supply favors the retention of the products of catabolism. For this reason water should be given in larger amounts than usual in fever, and in diseases associated with defective metabolism, for this, as will be seen in the chapter on metabolism, results in an accumulation of waste products in the system.

(5) Water tends to prevent irritation of the kidney cells by matter they are excreting. The quantity of water in the blood tends to remain constant; if there is loss of fluid from the body, as in hemorrhage, the amount of water will be temporarily reduced, but it soon passes from the tissues into the blood, and if the supply of water is limited from this or any other cause, less fluid will pass to the tissues and less will be excreted by the kidneys; consequently, the urine will be concentrated and, especially in fever and disease in which there is defective metabolism, some of the matter being excreted may be very irritating.

(6) The water of the blood is the main factor in distributing and equalizing heat in all parts

of the body and in distributing food to the tissues and carrying away waste.

(7) Water is one of the principal agents in heat regulation, since it is by the evaporation of sweat from the surface of the body that, under ordinary conditions of temperature, about one-third of the excess body heat is eliminated. That it is, is due to the fact that water requires heat in order to volatilize (536 small calories[1] for every gram of water volatilized), and this heat it takes from the body.

There are certain conditions, however, in which it is necessary to restrict the intake of water, or, in some cases, to give it in small quantities at a time, without lessening the total daily amount; chief among these are:

(1) When there is edema or dropsy. As mentioned in a preceding paragraph, when the blood becomes more concentrated than normal, water passes to it from the tissues; for this reason, restricting the amount of liquid favors absorption of water from the tissues and thus decreases the edema.

(2) In advanced cases of cardiac disease, caution must be observed in the amount of water given, since the heart may not be in a condition to propel the greater volume of blood, even though the increase is but temporary. When the condition is not associated with edema, the daily supply is not always actually lessened, but it must be given in small amounts at regular intervals.

[1] Defined on page

(3) During or immediately following hemorrhage, caution must be observed in the amount of water given at a time; for, though saline intravenous infusions are often given, even during a hemorrhage, it having been found that they increase the coagulability of the blood and thus favor the cessation of the hemorrhage, drinking water will not have this effect, and the vascular strain, which any large increase in the volume of the blood produces, may increase the hemorrhage.

(4) Water must be given with caution also to a patient with an aneurism, since any great distention may rupture the weakened artery.

Effect of Water on Digestion and Metabolism.—It was once thought that drinking water with meals interfered with digestion by diluting the gastric juice; but experiments have shown that at least one pint (one-half liter) can be taken without doing this to an extent sufficient to interfere with the action of the juice, and water aids digestion in the ways mentioned on page 50. The idea that an increase in the water supply hastened metabolism has also been proved untrue. This supposition was based on the fact that, after copious ingestion of liquid, the urine often contains an increased amount of nitrogenous waste, but it has been shown that this is due to increased elimination of the waste contained in the tissues and not to increase in their destruction.

Absorption and Elimination of Water.—Water is absorbed entirely from the intestine, and not

from the stomach, which is one reason why it is nearly always vomited if given after operation, before the motor activity of the stomach, which propels it into the intestine, is re-established. Water begins to pass from the stomach very shortly after it is taken, being ejected, slowly, in squirts, through the pylorus, so that a pint of cold water will have left the stomach in about three-quarters of an hour after it was taken and hot water in considerably less time, for the heat promotes muscular contractions of the stomach.

Under normal conditions, water not needed in the body will be eliminated, chiefly by the kidneys and skin, within three hours from the time that it is drunk.

The water eliminated from the body represents not only that taken in food and drinks, but also that formed in the tissues in the course of metabolism, as will be described later.

Constituents of Water.—Pure water, as its chemical formula (H_2O) shows, consists of hydrogen and oxygen. Water, however, is seldom found pure in nature, for being one of the best of solvents, it dissolves and absorbs matter from the ground through and over which it flows. Even rain water will contain bacteria and other matter as dust, absorbed during passage through the air. The impurity of rain water will depend upon: (1) the locality, being greatest in districts where there is much smoke, soot, or dust; (2) the length

of time the rain continues—the longer it falls, the purer it will be.

The foreign substances in water may be both organic and inorganic, and the organic matter may be of both animal and vegetable origin. When there is a large amount of animal organic matter in water, there is probably sewer infection and a large number of bacteria will undoubtedly be present. The presence of more than a small amount of sodium chlorid is another indication of sewage contamination. This is of course not the case when there is a large amount of sodium chlorid in the locality through which the water flows.

The more common inorganic constituents of water are sodium chlorid and carbonates and sulphates of calcium and magnesium.

Water in which there is enough mineral matter to form an insoluble curd with soap that is dissolved in it is called *hard water*, and the hardness of a water is estimated by the amount of soap that must be used before all the salts will become combined with it and allow of surplus soap forming suds.

When the hardness is due to carbonates it is known as *temporary hardness*,—because the water is easily rendered soft—*i. e.*, deprived of its mineral matter—by boiling, for, during boiling, CO_2 is liberated from the salts and this renders them insoluble, in consequence of which they are precipitated. Such precipitate shows as a dirty-looking

sediment on the sides and bottom of the utensil in which the water is heated.

Hardness due other substances than carbonates, naturally, cannot be remedied in this way, but the addition of such alkalies as borax, sodium carbonate, or ammonia will, by interacting with the salts causing either temporary or so-called *permanent hardness*, form insoluble compounds, which, being insoluble, will be precipitated.

Hard water is very objectionable for laundry work and, more than a moderate hardness, for cooking, but, except in a few parts of the world, the water used for drinking does not contain enough mineral matter to be injurious to health. There are localities, however, where there is so much mineral matter in the water that, especially when people are not accustomed to the water, digestive and intestinal disturbances may follow its use. Goiter and renal and biliary calculi have been attributed to the use of hard water, but it is now considered very doubtful if it does cause these conditions. Thus, as far as health is concerned, it is usually the presence of pathogenic bacteria that has to be considered.

Methods of Purifying Water.—The principal methods of purifying municipal water supplies are by sedimentation—such as is effected in reservoirs,—filtration, and, for some purposes, the use of chemicals as copper sulphate and alum. Household supplies are usually purified by filtration and boiling. Good filters, such as the

Berkfeld and Pasteur, will, if kept clean and periodically scalded, remove suspended matter and probably about 98 per cent. of bacteria, but not matter, such as salts, which is dissolved in the water. Boiling will destroy bacteria and remove the carbonates, but distillation is the only method by which all foreign substances can be removed. Distilled water, however, is not good for constant use as a drinking water, absolutely salt-free water being about as injurious to mucous membranes as that containing a large amount of salts. About eight grains of solid matter per gallon of water is considered a good proportion.

When there is a suspicion of an infected water supply, it is always advisable to boil the water used for drinking. The objection to this is that, on account of the loss of gases and carbonates, there is an objectionable flat taste to the water which prevents people drinking as much as they should. To minimize this effect, the water should not be boiled longer than necessary, about three minutes being usually sufficient, and it is well to pour it back and forth from one pitcher to another, to favor the entrance of air. The addition of a little fruit syrup will generally overcome children's objection to the use of boiled water.

Suspended matter, such as is often present after heavy rain, can usually be removed by adding powdered crystallized alum to the water, in the proportion of 5 or 6 milligrams to a liter of water. This interacts with the carbonates to

form calcium sulphate and a heavy, bulky precipitate of aluminum hydroxid which carries down the suspended matter. If the water is allowed to stand until precipitation is completed, the clear portion of the water can be easily poured off without disturbing the precipitate at the bottom of the flask.

Mineral and Aërated Waters.—Waters containing enough mineral matter to give them a flavor are known as *mineral waters*. The constituents of the mineral waters vary, but most of them contain some or other of the following, lithia, sulphur, iron, bicarbonates, sodium chlorid, and the alkaline salts of soda or lime. Such waters, when obtained from springs, are known as *natural mineral waters* and a water is often named after the locality in which the spring occurs. Artificial mineral waters are prepared by adding to ordinary drinking water or distilled water the salts which, by chemical analysis, have been found in the natural waters that the manufactured ones are intended to substitute.

Mineral waters and, sometimes, ordinary drinking water are charged with carbonic acid gas. Ordinary drinking water thus charged is called *aërated* or *carbonated water* and, incorrectly, *soda water*.

The carbon dioxid gas in natural and in some artificial waters is produced by the chemical interaction of the ingredients; for example, seltzer-water contains sodium chlorid, carbonate of

magnesium, bicarbonate of soda, and hydrochloric acid, and the interaction of the acid and the carbonates liberates CO_2 from the latter.

Action of Mineral and Carbonated Waters on Digestion.—A *moderate amount* of mineral water, when there are no conditions present to contraindicate its use, is rather an aid to digestion, since the sharp but, to most people, pleasant taste of the water tends to excite a psychic secretion[1] of digestive juices and the CO_2 stimulates the motor activity of the stomach and, by bubbling up through the material in the stomach, probably aids in its disintegration.

Carbonated waters should not be given when there is any tendency to cyanosis, for the CO_2 is rapidly absorbed and, if there is cyanosis, there is already too much CO_2 in the blood. Neither should they be given when there is gastric dilatation, for the gas favors distention; nor when the appetite is poor, since the CO_2 rather lessens the desire for food; nor should they be used to any extent by children, especially young children.

Accessory Foodstuffs

In addition to the organic and inorganic food constituents already described, there are, in some foods, certain substances that are neither, in the ordinary sense, foods nor condiments, but that are, nevertheless, necessary for health. These

[1] Explained under condiments.

substances are known by different names, *e. g.*, *accessory foodstuffs*, *accessory factors*, *vitamines*, and *vitines*. Their chemical nature is very imperfectly understood; it is not even known if those in different foods are chemically similar.

The best known member of the class is a basic compound found in the outer coatings of rice. The investigations which led to the discovery of this substance were started as the result of the discovery that, in countries in which rice was a staple article of food, diseases such as beri-beri and scurvy were prevalent among the natives using rice prepared by modern methods of milling, while those who subsisted on that prepared by primitive methods were exempt from these diseases.

Primitive methods of milling rice consist in grinding the whole seed between heavy stones, but in new methods the outer coats are removed, giving as a result the so-called *polished rice*.

By feeding experiments with birds and animals, it has been found that a substance with similar action to that isolated from the outer coatings of rice is contained in the outer coat of other cereals, and also in potatoes and fresh vegetables, in fruit juices, especially that of limes, in fresh milk, eggs, and fresh meat.

How these substances exert their influence is not understood; but pigeons that were killed after they had been fed for some time on cereals from which the outer coats had been removed, were

found to have abnormal conditions of those ductless glands which manufacture the internal secretions concerned with metabolism. Thus it is thought possible that the vitamines may be necessary for the formation of the active principles of these secretions.

PART II

DIGESTION AND METABOLISM

CHAPTER IV

DIGESTION

Reason for Digestion.—Water, salts, and the glucoses are ready for absorption and utilization by the body without change; disaccharids can be absorbed unchanged, and are when eaten in large quantities, but apparently they cannot be utilized by the system, for they are promptly eliminated by the kidneys in the urine. The other food substances, being insoluble in water and indiffusible, are not absorbed. Therefore, certain changes must be made in all organic foodstuffs, except glucose, before they can be of any use to the body, and these changes constitute digestion. As the result of digestion, insoluble foods are rendered soluble and in the process complex substances are reduced to simple ones from which, after their absorption, the body cells can pick out those that they require and are able to use, or which, under existing conditions, are readily oxidized.

Nature of Digestion.—The processes occurring

in digestion are of two kinds: viz., physical and chemical. The physical processes include:

(1) Mastication, in which the food is broken by the teeth and mixed with the saliva.

(2) Deglutition or swallowing.

(3) The mechanical action of the stomach, by reason of which the food is pressed back and forth and separated so that it becomes saturated with the gastric juice and, as digestion proceeds, is forced into the duodenum.

(4) The mechanical action of the intestine, by which the material received from the stomach is mixed with the pancreatic and intestinal juices and the bile, is pressed against the walls of the intestine to further its absorption, and, until absorbed, is passed slowly along the length of first the small and then the large intestine until the residue reaches the rectum, from which it is discharged by the process of *defecation.*

Chemical digestion consists of a process known as *hydrolysis, i. e., chemic decomposition due to the absorption of water.* The change of a disaccharid to a monosaccharid illustrates this; the chemical formula for a disaccharid is $C_{12}H_{22}O_{11}$ that for a monosaccharid is $C_6H_{12}O_6$; what occurs is

$$C_{12}H_{22}O_{11}+H_2O=2C_6H_{12}O_6$$

(*i. e.*, each molecule of a disaccharid unites chemically with a molecule of water and in doing so splits, so that it yields two molecules of a monosaccharid). In the digestion of starch and proteins, the nature of the reaction is similar, but it is re-

peated an unknown, but varying and great, number of times.

Names of the Digestive Juices and the Glands Secreting them.—The chemical changes wrought in food are brought about by the agency of secretions of glands contained in the lining of the alimentary organs or connecting with them by means of ducts. These secretions are known collectively as the *digestive juices*. The names of the various glands are:

The salivary glands, which secrete the saliva (for the names of the various salivary glands see anatomy).

The gastric glands, which secrete the gastric juice.

The pancreas, which secretes the pancreatic juice.

The crypts of Lieberkühn or intestinal glands, which secrete the *succus entericus* or intestinal juice.

The liver, which secretes the bile.

The salivary glands discharge their secretion into the mouth; the gastric glands empty theirs into the stomach; the pancreatic juice is emptied from the pancreatic duct into the common bile duct and thence into the duodenum; the succus entericus is discharged into the lumen of the intestine, and the bile through the hepatic and cystic ducts into the common bile duct and thence into the duodenum.

Nature of the Digestive Juices and their Constituents.—The digestive juices, other than the bile, consist of water, salts, some simple proteins such as the mucin of the saliva, which gives that juice its viscid nature, and enzymes or ferments, which are the active principles of the juices.

Enzymes.—The chemical composition of these substances is still but imperfectly known. Howell defines them as *organic substances derived from proteins and of a colloidal nature.*[1] They are called catalyzers,[2] because, like inorganic catalyzers, they hasten the reactions. They do not enter into the reaction and are not destroyed by it. It is because of the enzymes that hydrolysis takes place at a comparatively low temperature.

Characteristics: Enzymes are specific in their action, *i. e.*, the enzyme that aids in the digestion of one foodstuff will have no effect upon others. They are affected by temperature: for those of the animal body, the optimum temperature is, naturally, that of the body; a high temperature will destroy them, a low temperature will retard their action. Their activity is altered also by the reaction of their surroundings: the enzymes of the saliva require a neutral or slightly acid or alkaline medium; those of the gastric juice, an acid; those of the intestinal and pancreatic juices, an alkaline.

Enzymes which aid in the digestion of starch are called *amylolytic enzymes;* those which act on proteins, *proteolytic;* those which split fats, *lypolytic;* those which invert sugars, *inversives.*

Zymogens.—Some of the enzymes are in an inactive state so long as they are retained in the

[1] *Text-Book of Physiology*, p. 717. Howell, Saunders & Co.

[2] Catalyzers are substances which hasten chemical reactions, but do not themselves enter into the reaction.

cell producing them, and only become active by the influence of some other substance at the time of secretion, or sometimes, as in the case of the trypsinogen of the pancreatic juice, after they have been discharged from the gland in which they are produced. Such inactive enzymes or, as they are often called, *antecedents or precursors of enzymes* are known as *zymogens.*

Kinases.—The agents which convert inactive into active enzymes are called *kinases.* The change is, in many instances, the result of the removal of some portion of the zymogen by the kinase.

Hormones.—These are chemic substances which, after absorption by the blood from the gland producing them, will activate, or increase the action in, organs to which they are taken by the blood. The hormones of importance in digestion are the secretins, which will be referred to in a following paragraph.

Ferments in the Different Digestive Juices.

The saliva contains ptyalin and, probably, a small amount of maltase. These act upon starch.

The gastric juice contains: rennin, which coagulates milk; pepsin, which begins the digestion of proteins; gastric lipase, which digests some of the emulsified fats such as cream. Another very essential constituent of the gastric juice is its hydrochloric acid, which, during digestion, is manufactured by certain cells in the gastric

mucosa from sodium chlorid taken from the blood. The acid is, of course, not a ferment, but the pepsin ferment will not act except in the presence of about 0.2 to 0.4 per cent. HCl; a much higher per cent. will render it inactive however. The acid acts also as a disinfectant; there would be more danger of diseases due to bacteria that gain entrance through the alimentary canal, were there no HCl in the gastric juice. It also helps regulate the passage of food from the stomach; the way in which it does so will be described later, and, as will be seen in following paragraphs, the acid chyme[1] is the activating agent of the intestinal secretin, the function of which will be described later.

The ferments of the **pancreatic juice** are: Amylopsin, which is concerned with the digestion of starch; lipase or steapsin, which assists the digestion of fats; and the zymogen trypsinogen, which, after it has been converted into trypsin by the enterokinase of the intestinal juice, continues the digestion of proteins.

In the intestinal juice are erepsin, which finishes the digestion of proteins; maltase, which converts maltose into glucose; sucrase, which inverts sucroses, thereby forming glucose and levulose; galactase, which splits lactose to glucose and galactose; enterokinase, which activates the trypsinogen of the pancreatic juice.

[1] The material resulting from gastric digestion. It is acid owing to its admixture with HCl.

No ferment has been found in the **bile.** The constituents of this secretion are: water, bile salts, protein substances, bile pigments, cholesterin, lecithin, fats, and inorganic salts.

Factors Influencing the Secretion of Digestive Juices.—The glands secreting the various digestive juices are stimulated by the action of the nervous system and by hormones known as *secretins*.

The secretion of the saliva is excited normally by nerve impulses which arise in the mouth and pharynx, especially as the result of: (*a*) the contact of food with the mucous membrane of the mouth and gustatory[1] nerve-endings; (*b*) the stimulation of the olfactory[2] nerve-endings; (*c*) the movements of the jaw. Thus the smell and taste, sometimes even the thought, of food may induce secretion of saliva. This is termed *psychic secretion*. Saliva is usually more abundantly produced when the individual is hungry and when the odor and taste of the food are pleasing. Under other conditions secretion may be even inhibited, as it is also by painful emotions such as fear, nervousness, anger.

The gastric, like the salivary, glands are stimulated by the sight and smell of food—psychic secretion—and by the presence of food in the stomach. Another and one of the most active excitants of gastric secretion is the hormone called *gastric secretin*, which is formed in the mucous membrane of the pyloric end of the stomach. This is absorbed by the blood and carried by it

[1] Nerve of taste. [2] Nerve of smell.

back to the stomach to the glands which secrete the gastric juice. Stimulation by this means is spoken of as *chemic secretion*. Products of the digestion of some foods also serve as chemic stimulants of the gastric juice.

The quantity of gastric juice secreted, the rapidity of its secretion and the proportion of ferments and acid varies with different diets. Thus, the juice secreted on a bread diet is much stronger in ferment than that produced on a meat diet, and a meat diet produces a juice containing more pepsin and acid than a milk diet. It is not known whether these differences are due to any special stimulus in the different foods.

The secretion of the gastric juice, like that of the saliva, is inhibited by lack of appetite, dislike of food, anger, worry, and so forth. Thus it can be seen that appetite, food pleasing to the taste, and freedom from disturbing psychic influences are of importance for the rapid digestion of foods. Certain experimenters, however, consider that, though these things influence the rate of digestion, they make but little difference in the degree of digestion—*i. e.*, a longer time will be required for digestion, but ultimately the food will be as thoroughly digested and absorbed as under the more favorable conditions.

The pancreatic secretion, experiments have shown, is influenced to some extent by nerve stimulation, but by far the most important factor in pancreatic stimulation is the hormone secretin,

which is produced from a substance called *pro-secretin* by the action upon it of the acid entering the duodenum from the stomach. The prosecretin is secreted by certain cells in the intestinal mucous membrane.

The chemical nature of secretin has not as yet been determined. It is absorbed by the blood, and when carried to the pancreas it stimulates that organ. The intestinal secretion may also, it is thought, be stimulated by the secretin or some similar hormone, but as yet very little is known regarding the manner in which the intestinal glands are stimulated, except that the formation of enterokinase—which activates the trypsinogen—is stimulated by the entrance of the pancreatic juice into the intestine.

The proportion of ferments in the pancreatic juice, like that of the gastric, varies according to the diet; *e. g.*, a meal of bread will give rise to a juice relatively rich in amylolytic (starch-splitting) ferment, but poor in lipase, while the juice brought on by a meal of meat or milk will contain more lipase but less amylopsin.

Though the secretion of the digestive juices takes place only during digestion, the formation of the enzymes and their precursors goes on during the intervals of rest, and they are stored in the cells in the form of granules. These, when the glands are stimulated in the various ways described, are moved toward the gland ducts and then discharged.

The secretion of bile, unlike that of the other digestive juices, goes on continuously, though during fasting no bile enters the intestine. When food is taken, however, the flow begins and lasts as long as digestion continues, and during digestion the secretion of the bile is accelerated.

The quantity and quality of bile produced vary somewhat with the nature of the food taken, the secretion being most abundant and richer in bile salts when the meal contains a large amount of fat. This is thought to be due to the fact that the bile salts are absorbed with the products of the digested fats, and these on being carried to the liver excite the activity of the hepatic cells.

Functions of Bile.—It favors the activity of the pancreatic ferments, especially the lipase; it aids in changing the reaction of the chyme, as the product of gastric digestion is called, from acid to alkaline and thus renders its condition favorable for intestinal digestion. It aids in the absorption of fats and it has a mild laxative effect—an insufficient secretion of bile is likely to be associated with lessened peristaltic action in the intestine and consequent constipation.

Changes Made in Foodstuffs by Digestion

In the mouth, the solid food is broken by the teeth and mixed with the saliva; this renders sapid substances capable of affecting the endings of the nerves of smell and taste and facilitates swallowing, but the only chemical change made

is in the starch. Some of this, by the action of the ptyalin, is changed to dextrins and a small amount of the achrodextrin to maltose.

In the stomach, the digestion of the starch continues for a short time, because of the ptyalin with which it became mixed in the mouth. However, ptyalin is destroyed by acid and thus, as the starch becomes mixed with the gastric juice, its digestion ceases. A small amount of sucrose may be hydrolized by the hydrochloric acid; some of the emulsified fats—as cream—may be partially digested by the gastric lipase; and all fats are freed from the proteins surrounding them, thus preparing them for digestion in the intestines. It is, however, the proteins that undergo the greatest change in the stomach; the caseinogen of milk is clotted, being changed to casein; the nucleoproteins are split to nucleins and proteins and the latter, like other proteins, by the influence of the pepsin plus the hydrochloric acid, go through the various stages of protein digestion forming the substances classed as metaproteins and proteoses and even some peptones.

In the intestine, by the action of the trypsin of the pancreatic juice, the remaining proteoses are changed to peptones, and these, chiefly by the action of the erepsin, are changed to peptids which, it will be remembered, are simple combinations of amino-acids. The fats, by the lipase of the pancreatic juice, the alkaline salts and the bile are (1) emulsified, (2) split to fatty acids and glycerin,

(3) saponified. Undigested starch is changed to dextrins and these to maltose by the amylopsin of the pancreatic juice; maltose is changed to glucose by the maltase of the intestinal juice; sucroses to glucose and levulose by the sucrase; and lactose to glucose and galactose by the lactase of the intestinal juice. Some of the nucleins split from the nucleoproteins during gastric digestion are absorbed as such, but a portion of them, by the action of the pancreatic and intestinal juices, undergo further splittings, yielding nucleic and phosphoric acids, and simple protein and carbohydrate molecules.

Passage of Food from the Stomach to the Intestine.—When the stomach is empty, it is in a collapsed condition and any lubricating secretion within it is of a neutral or even slightly alkaline reaction. As soon as food is taken into the mouth, gastric secretion begins. For the first twenty to forty minutes, there is no free hydrochloric acid, all that formed being taken up by the protein food entering the stomach. After this has combined with all the acid that it can hold some acid will remain free and, when this occurs, the sphincter muscle that keeps the exit between the stomach and duodenum closed, relaxes and some of the food, pressed toward the pylorus by the movement of the stomach, passes into the intestine. The acid, on the intestinal side of the pylorus has the opposite effect that it has on the gastric side, so that the muscle contracts and the orifice is closed

and remains closed until the reaction of the intestinal contents is once more alkaline. Then it relaxes again and some more chyme passes into the duodenum, and so on. It will take from about three to five hours for the whole of an ordinary meal to pass from the stomach.

Table Showing the Enzymes in the Digestive Juices and their Action on Food

Digestive Juice	Enzyme	Action on Food
Saliva	Ptyaline Maltase	Turns starch to dextrine and maltose. Turns maltose to dextrose.
Gastric Juice	Rennet Pepsin plus Hydrochloric Acid	Coagulates milk. Splits proteins to proteoses and peptones Liberates fats from protein. Slight inversion of sugar by HCl.
Pancreatic Juice	Amylopsin Trypsinogen	Continues work of ptyalin. Continues work of pepsin, changing proteoses into peptones and amino-acids.
Intestinal Juice	Lipase or Steapsin Erepsin Sucrase Maltase Lactase	Decomposes fats into fatty acids and glycerine. Continues work of pepsin and trypsin, splitting peptones to amino-acids and ammonia. Inverts sucrose to dextrose and levulose. Changes maltose to dextrose. Changes lactose to dextrose and galactose.
Bile	No known enzyme	Aids the lipase in splitting fats to fatty acids and glycerine. Assists the alkalies of the pancreatic and intestinal juices in the saponification of the fatty acids, and aids in their absorption.

Effect of Bacteria on Digestion.—In the large intestine and lower part of the small intestine, there are always a large number of bacteria present. These produce changes in food very similar to those induced by the ferments; also, they decompose cellulose. Thus, provided that their action is not excessive, bacteria act as rather beneficial auxiliaries to the ferments. But when there is constipation or other abnormal condition in the intestines, bacterial action may be carried too far and a large amount of putrefactive products, such as tyrosin, indol, phenol, and skatol may be produced and absorbed and induce undesirable symptoms. Metchnikoff, a noted Russian physiologist, has advanced the theory that the conditions present in old age may be brought on prematurely by the constant absorption of these substances.

What is Meant by the Digestibility of Food.—By the digestibility of a food may be meant either the rapidity of its digestion, the relative frequency of its promoting digestive disturbances, or the extent to which a food is digested. Some foods that are not very rapidly digested will ultimately leave quite as little residue as do some others that are quickly digested, and many that leave considerable cellulose residue do not tax the digestive organs to the extent, nor cause the digestive disturbances, that some do which in time are relatively fully digested.

In health, it is not necessary, nor even desirable, that all food taken should be rapidly nor even

fully digested, since residue promotes peristalsis, but in diseased conditions it is often essential to spare the organs of digestion all unnecessary work, and in many cases they are unable to perform their work, and under such circumstances it becomes necessary to use foods which are readily and quickly digested.

Even in health, foods that have a tendency to cause digestive disturbances should not be taken in large amounts. For some as yet undiscovered reason, there are people who have an idiosyncrasy which causes some food or foods, even such as are ordinarily easily digested, to disagree with them.

How Facts Concerning Digestion Have Been Ascertained

The X-ray has been one of the most important means of ascertaining the nature of the mechanical processes of digestion, while the chemical processes have been studied chiefly with animals in which, by operation, fistulas have been made into the stomach and intestines, and tubes that could be opened and closed at will inserted in the fistulas. In this way it has been possible to obtain the various juices as they were secreted and to note the time of secretion and factors accelerating it. Some other important means of study that have been used are: (1) Making extracts of different parts of the stomach and intestines, etc., of animals

after death, and testing the action of these extracts on the different foodstuffs. (2) Extracting matter from the human stomach by lavage or expression. (3) Extracting matter from the stomach through the fistula made in patients who have had a gastrostomy operation performed. Descriptions of such experiments and also those by means of which metabolic processes have been studied can be found in any book of general physiology written for medical students, and in *Government Bulletin No. 175:* "Experiments on the Metabolism of Matter and Energy in the Human Body."

CHAPTER V

ABSORPTION AND METABOLISM

Absorption

Where and How Absorption Takes Place.—Absorption of foodstuffs takes place mainly in the small intestine. A few substances, especially alcoholic solutions, may be absorbed from the stomach; water and salts and a considerable portion of absorbable material that reaches the large intestine or that becomes digested there (with the help of the enzymes that became mixed with it in the small intestine, and bacteria) will be absorbed from the colon, but under normal conditions only a small amount of such matter reaches the large intestine.

Intestinal digestion and absorption are taking place at the same time; as soon as any amino acids, glucose, and soap are formed, they, and probably some unsaponified fatty acids and glycerin, pass from the intestine; the two first mentioned passing into the blood-vessels, but the products of fat digestion chiefly into the lymph-vessels (lacteals) that are in the villi projecting into the lumen of the intestine.

Space will not permit description of the various theories regarding the mechanism of absorption further than to state that the products of carbohydrate and protein digestion are absorbed in the form to which they have been reduced in digestion, but that at least the greater part of the fatty acids and glycerin unite to form neutral fats during absorption. The agent causing this reconstruction is, it is thought, lipase; probably, the same enzyme that was concerned in the digestion of the fat. For it has been shown that lipase, like many other enzymes, will reverse its action in the presence of much material formed in the reactions which it brings about.

Until very recently, it was stated that protein also underwent reconstruction during absorption, because amino acids were not found in either the portal or general circulation, but lately, improved methods of investigation having been devised, amino acids have been found in the blood. The fact that they are found only in very small amounts is now thought to be due to (1) the slowness of absorption, (2) the rapidity with which they are taken up by the tissues, (3) the relatively large amount of blood in which they are dissolved.

Metabolism

Meaning and Nature of Metabolism.—By metabolism is meant the changes that occur in foodstuffs from the time they are absorbed until they

are eliminated. This, as the tissues are made from the food-derivatives, naturally includes the various processes by which tissues are built and repaired and in which their substance is destroyed.

Building or synthetical metabolic processes are classed as *anabolism* or *anabolic processes*. Those of decomposition as *katabolism* or *katabolic processes*.

Fate of the Carbohydrates in Metabolism.—All forms of carbohydrate food during digestion are, it will be remembered, reduced to monosaccharids; these are classed collectively as glucoses.

The glucose is carried, after absorption, via the portal vein, to the liver, where that not at once required is changed to glycogen. This is stored until needed in the liver and muscles.

The glycogen stored in the muscles is intended mainly for their own nutrition, while that retained in the liver is gradually changed back to glucose as the blood requires it. Normally, the glycogen obtained from the glucose of a meal containing the amount of sugar and starches usually eaten will have been pretty well used up before a fresh supply is obtained from a following meal.

The need of the blood for glucose arises from the fact that its glucose supply is constantly passing into the tissues where it is decomposed. The blood in health maintains a constant glucose content of about 0.1 to 0.2 per cent.; as it loses of its supply it, as just stated, obtains more from the glycogen; the manner in which it gets rid of an overabundant supply will be discussed later.

The nature of the processes and the stages in the decomposition of glucose are not well understood. Under differing conditions, the glucose molecule will, by splitting and oxidation, give rise to a number of different substances, and just which of these are produced in the body before the ultimate decomposition of the glucose to CO_2 and H_2O is arrived at is but imperfectly known.

It is known, however, that lactic and other acids are formed and that these are finally oxidized to CO_2 and H_2O,—the substances, it will be seen, from which glucose was constructed in the plant. As the result of the oxidation of the glucose, the energy obtained from the sun is once more liberated, thus providing heat and the power to do work. The fuel value of glucose will be discussed later.

Agents Which Promote Chemical Changes in Glucose.—The changes of glucose to glycogen and of glycogen to glucose, experiments seem to show, depend largely upon an enzyme or enzymes. The force regulating the rate at which glycogen is built up and decomposed again to glucose as the blood needs it is not known, but it is thought to be of nerve origin. Some investigators believe that there is a "sugar centre," but neither the centre nor the manner in which it is stimulated or exerts its control has been discovered.

Enzymes and internal secretions, especially the internal secretion of the pancreas, are the principal agents causing the splittings and oxidative pro-

cesses occurring in glucose in the tissues. Just how the internal secretions act is not understood; what is known beyond doubt is, that, if disease of the pancreas even partially destroys the cells which furnish its internal secretion, the oxidation of glucose is inhibited and the disease known as *diabetes mellitus* ensues.

The amount of glucose oxidized in the body depends chiefly upon the degree of muscular contraction that occurs, and this, in turn, depends upon several conditions that will be discussed in Chapter XII.

Function of Glucose.—(1) The chief use of glucose in the body is for fuel. (2) It is utilized in preventing undue loss of protein matter; *e. g.*, experiments have shown that when carbohydrates are eliminated from the diet, extra fats being used as a substitute, creatin (a simple nitrogenous substance derived from the katabolism of body tissue) appears in the urine, and under normal conditions this is not the case if carbohydrates are used in the usual proportions; thus it is thought that, with the help of glucose, resynthesis of creatin into cell protein takes place. Hence glucose is called a *tissue sparer*. (3) If more carbohydrate food is eaten than can be oxidized at the time or stored as glycogen, some of the resulting glucose will be converted into fat, but, if the excess is great, some of the supply will be at once eliminated in the urine.

Metabolism of Fat.—As previously stated, some

of the fat taken as food is, after digestion, absorbed by the blood-vessels of the intestinal villi, but the greater part enters the lacteals and passes thence through other lymph vessels to the great thoracic duct, which opens into the left innominate vein; thus, whether absorbed by the lymph or blood-capillaries, the fat eventually enters the blood stream, and that not oxidized is taken up by the tissues, much of it without change. It is stored in the connective tissue known as adipose or fatty tissue and in practically all cells, since it is one of the constituents of protoplasm.

All the fat, whether taken as such in food or formed in the body from glucose, is, sooner or later, split and oxidized to carbon dioxid and water, providing heat and energy by the process, and as fats contain less oxygen than the other foodstuffs they have a higher fuel value, since the less oxygen there is in a compound the more the other elements will unite with in combustion.

How fat passes from the blood into the cells and, when required, is enabled to again pass out of them; the various stages in its decomposition and how this decomposition is brought about, are not definitely known. It is thought, however, that the cells form lipase, which aids in both the decomposition and synthesis of fats, and that they are first split to glycerin and fatty acids and then the latter decomposed into more simple fatty acids and, finally, these and the glycerin oxidized to CO_2 and H_2O.

When fat metabolism is defective, aceto-acetic and oxy-butyric acids and acetone are formed and eliminated in the urine.

Function of Fat.—The fat of food and that synthesized in the body are used to replace that lost from tissue in its normal katabolism; also it serves as a reserve fuel material—*i. e.*, the adipose tissue is broken down and oxidized when, for any reason, the supply of food is not adequate for the fuel requirements; it protects delicate body structures from friction and injury, helps to hold the organs in place, and when not in excess is an aid to beauty of figure.

Metabolism of Proteins.—As previously mentioned, it was thought, until recently, that the amino acids formed from proteins as the result of digestion were resynthesized into proteins during absorption. Recent discoveries, however, have given rise to the opinion that the amino acids are absorbed into the blood as amino acids and pass in this form into the tissues, and that, during the years of growth, as much of these as required is used to build tissue and, both in youth and after growth has ceased, to replace material in the tissues that has been broken down, *i. e.*, katabolized. The amino acids not needed for these purposes undergo cleavage in which the nitrogen is split off in combination with hydrogen in the form of ammonia. This removal of ammonia is spoken of as *deamination.* The ammonia, by uniting with carbon dioxid and undergoing oxidation and

other chemical changes, is converted into urea. Formerly, it was considered that this conversion of amino acids into urea took place only in the liver, but now it is thought probable that it occurs in the tissues as well as in the liver.

The urea is absorbed and carried by the blood to the kidneys for elimination in the urine. There are also eliminated in the urine small amounts of substances such as ammonia salts and creatinin[1]; these substances represent intermediary products of protein metabolism that have not been as thoroughly decomposed as that converted into urea. As a rule, greater amounts of such substances than usual are found in the urine after the intake of large amounts of protein food and when protein metabolism is defective.

When the ammonia is split from the amino-acid molecule, the remaining hydrogen and the carbon and oxygen are left in the form of acids of the fatty acid type and the sulphur of the protein is set free. The acids are, for the most part, oxidized to carbon dioxid and water, energy being liberated in the process. Glucose can be and, at least sometimes, is produced from this part of the protein molecule.

The sulphur set free unites with hydrogen and oxygen to form sulphuric acid (H_2SO_4), which at once combines with alkaline substances to form

[1] This is not the same as creatin, referred to in a preceding paragraph, but they both yield uric acid on decomposition.

salts. This is the chief source of the sulphates eliminated in the urine.

Metabolism of the Nucleoproteins.—It will be remembered that in digestion the proteins of the nuclei of cells—the nucleoproteins—are split into nucleins and proteins and some of the nucleins into very simple protein and nucleic and phosphoric acids. After absorption by the blood, some of the nucleins and nucleic acids are utilized in the tissues to take the place of those destroyed in katabolism. Surplus nucleins and nucleic acids taken with food, as well as those destroyed in tissue katabolism, are gradually decomposed, giving rise to phosphoric acid and substances that are known as *purin compounds*, of which the final decomposition product is uric acid.

The phosphoric acid split from the nucleic acids in the course of digestion and of metabolism is used for the resynthesis of nucleoproteins and for other necessary phosphorus compounds. That not needed for the purpose and that set free in form katabolism unite with alkaline substances to phosphates and as such are excreted.

Summary of Metabolism

After absorption the food material is carried by the blood to the tissues where that which the tissues and other body compounds need and can use for their building or repair is taken and utilized. That not needed for such uses is broken down,

largely by oxidative processes. As the result of this decomposition, energy is liberated.

This energy is utilized in the body for: (1) the performance of external work—*i. e.*, that done by the voluntary muscles; (2) to maintain muscle tone; (3) to maintain the activities of the internal organs; (4) as heat.

The final products of carbohydrate and fat katabolism are carbon dioxid and water and the principal intermediary products are acids. The final products of protein katabolism are urea and small amounts of ammonia salts and similar substances and carbon dioxid and water. The final product of nuclein katabolism is uric acid and the chief intermediary products are the purin bodies and allied substances and phosphoric acid which is converted into phosphates.

When, for any reason, metabolism is defective, the intermediary products of katabolism are not as quickly nor as thoroughly decomposed as under normal conditions and there is likely to be an accumulation of acids in the system.

Exogenous and Endogenous Waste.—The products of the katabolism of food material that have not been built into tissue are spoken of as *exogenous waste* and those derived from tissue as *endogenous*. For example, the uric acid derived from the cell nuclei of body tissue is called *endogenous uric acid* and that derived from food, *exogenous uric acid*.

The Fuel Value of Food

By burning food in special forms of calorimeters, it has been found that each kind of foodstuff yields a certain amount of heat, carbohydrates yielding 4.1 calories[1] per gram; fats, 9.45 calories per gram; proteins, 5.45 calories per gram.

The body, however, does not get quite this amount of heat from food that is eaten, because there is always a small amount of loss in digestion, and in the case of proteins there is a greater loss than with the other foodstuffs because, in the calorimeter, the proteins are completely oxidized to carbon dioxid, water, and nitrogen gas, while, in the body, the nitrogen and some of the hydrogen are not completely metabolized, being eliminated in the form of urea, uric acid, etc.

From numerous analyses of feces, it has been estimated that, of an ordinary mixed diet approximately, on an average, 2 per cent. of the carbohydrate, 5 per cent. of the fat, and 8 per cent.

[1] The calory is the unit used in stating the amount of heat. What is known as the *small calory* is the amount of heat that is required to raise a gram of water from 0 to 1 degree centigrade. The amount of heat necessary to raise a kilogram of water from 0 to 1 degree centigrade is called the *large calory*. It is the large calory which is now generally used in computing the fuel value of food.

The difference between the degree of heat or temperature and the amount of heat may be illustrated as follows: The temperature of six ounces of boiling water will be the same as that of a gallon of boiling water, viz., 212° F., but there will be a much larger amount of heat in the utensil containing the gallon than in that holding the six ounces of water.

of the proteins escape digestion and are eliminated in the feces. Therefore, in order to make allowance for the amount of material lost in excreta, the fuel value of carbohydrate is given as four calories per gram; of fat, nine calories per gram; and of protein, four calories per gram. Formerly higher estimates than these were given, viz.:

Carbohydrates....................	4.1 calories per gram
Fat.............................	9.3 " " "
Protein.........................	4.1 " " "

but the investigations and experiments from which the estimates were made were conducted with dogs, and it has been found that, ordinarily, in humans there is a greater loss of material in digestion than in dogs.

PART III

NATURE AND NUTRITIVE VALUE OF SOME TYPICAL FOODS

CHAPTER VI

ANIMAL FOODS

Meat and Birds

Composition—Nutritive Value—Comparative Digestibility—Signs of Fresh Meat—Methods of Preservation

THE more common animal foods include the flesh of the mammalia—generally spoken of as *meat*—birds, fish and other sea food, eggs, milk and its derivatives, honey.

With the exception of honey, milk, liver, and shellfish, the only solids provided by animal foods are protein, fats, and mineral matter. The protein of animal foods, however, is particularly valuable, for though many of the plant foods contain quite large amounts of protein and can be used as substitutes for animal foods, recent experiments and investigations have shown that the various amino acids are not in quite the same relative proportions in the two classes of foods and, as might be expected, the combinations in animal foods more nearly resemble those of human tissue. For this reason, a larger supply of vegetable than

of animal protein is necessary to get a sufficient amount of essential amino acids, and thus animal protein has a higher nutritive value than vegetable protein. Dr. Graham Lusk in his book, *The Fundamental Basis of Nutrition*, says: "Plant proteins are eaten by the ox and are reconstructed into beef proteins, with the oxidative elimination of the excess chemical units which are unnecessary for the structure of the animal cell. In this way beef attains a higher biological value for the nutrition of man than is possessed by vegetable proteins."[1]

Meat

Composition and General Characteristics.—Meat is composed of bundles of muscle fibers held together by connective tissue, with a certain amount of fat interspersed between the fibers. Under the microscope, these fibers are shown to be minute tube-shaped cells filled with a watery fluid containing proteins, salts, and extractives. The principal nitrogenous substances of meat are the proteins and extractives of the fibers, and the gelatinoids of the connective tissue. The chief proteins and the action of heat, saline solution, and water on them can be seen in the following table:

[1] *The Fundamental Basis of Nutrition*, p. 18. Lusk. Yale University Press.

1	Myosin (a globulin)in muscle Serum-globulin, in blood Fibrin, in blood Globin, in hemoglobin	Insoluble in water, but soluble in dilute saline solutions; coagulated by heat.
2	Serum albumin, in blood Muscle albumin	Soluble in water and dilute saline solutions; coagulated by heat.

Myosin coagulates soon after the death of an animal, giving rise to the condition known as *rigor mortis* or *death-stiffening*. After a time, the length depending upon such conditions as the temperatures of the surroundings and the species of animal, this stiffness gradually disappears, due to changes in the coagulated myosin. These are brought about as sarcolactic acid, acid phosphates, and other acids accumulate in the flesh. The production of acid and of changes in the myosin is influenced primarily, it is thought, by intracellular enzymes and, also, by bacteria. The acid is partly derived from the glycogen of the muscles, and this being thus destroyed, liver is the only meat containing carbohydrate. In addition to softening the tissue of meat, acids give flavor to the meat, and that used immediately after the death of an animal is insipid. The flesh of animals killed during, or just after, strenuous exercise, as in the chase, contains more acid than that of those killed in the usual manner, and thus it has a special flavor.

The chief **gelatinoid** of meat is the collagen of

the connective tissue, which, when boiled, is converted into gelatin.

The **extractives** or **meat bases** give much of the characteristic flavors to the various kinds of meat. They also stimulate the secretion of the gastric juice, and have a slight general stimulant effect similar to that of spices, described in Chapter XI. Beef and game have more extractive matter than other meats.

Fat is found in masses and, though in greatly varying amounts, in the connective tissue, between the fibers, even in the lean parts of meats. When present in large amounts, fat tends to lessen the digestibility of meat because it, by surrounding the fibers, tends to hinder the penetration of the gastric juice and thus interferes with the action of the juice on the meat. Also, fat tends to retard the secretion of gastric juice. It increases the nutritive value of meat, however, as it replaces water, and not protein, in the muscle.

The proportion of **water** in meat varies greatly in the different kinds and cuts. Young animals have a larger proportion than older ones and lean cuts than fat ones.

The **mineral matter** of meat consists chiefly of phosphates of potash and, in the hemoglobin, iron. The amount of hemoglobin in meat varies, being less in young animals than old ones and almost absent in the flesh of those that have been bled to death; hence the lack of color in veal.

Factors Influencing the Value of Meat.—The

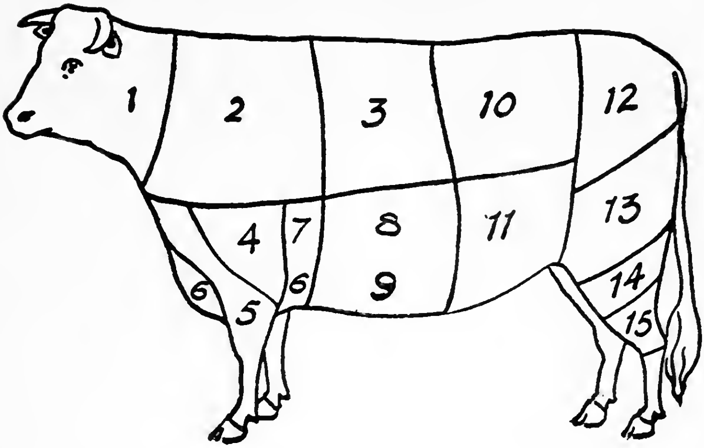
toughness or tenderness of meat depends largely upon: (1) The length of the fibers—the shorter the fibers, the more tender the meat will be. (2) The age of the animal; the fibers of older animals tend to have thicker walls and more connective tissue than those of younger ones and thus the meat will not be as tender. (3) The part of the animal from which the meat is taken; this will be discussed later. (4) The length of time the meat is kept after the animal is killed; when an animal is first killed, the flesh is comparatively soft, juicy, and tender, though rather tasteless, but rigor mortis soon sets in and the flesh becomes hard and tough. As acids develop, the meat becomes more tender and has an acquired flavor. The length of time that it is best for meat to be kept depends upon the variety; beef should hang at least three weeks and mutton is better if it hangs longer, but the flesh of young animals, like lamb, is immature and spoils easily, so it should hang only for a few days. The temperature of the chamber in which the meat is kept while "ripening" should be slightly above freezing point. Too low a temperature prevents the action of bacteria, which is of importance in the softening of the myosin, while in a high temperature the bacteria become over-active and the process of decomposition is carried too far. When meat is kept beyond the time necessary for "ripening," as in cold storage, the temperature must be maintained at a uniform degree and low enough to

check bacterial action; this is usually about from 31° to 35° F., and sometimes it is frozen. (5) The method of cooking; this will be discussed in the recipes.

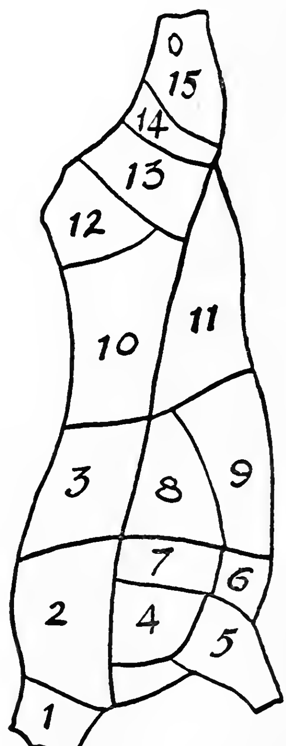
The **flavor of meat** depends largely, as already stated, upon the acids developed during "ripening" and upon the extractives, but it is also influenced by the food that the animal had, the condition of the animal when slaughtered, and all the factors mentioned in the preceding paragraph; also, the nature of the fat makes a difference in the flavor. This last is especially true of meats, such as pork and mutton, which have not a great supply of extractive matter.

Different Cuts of Meat.[1]—The quality of meat, both as regards its tenderness and flavor, varies greatly with the part of the animal from which the meat was taken. In all animals the parts that have had the most exercise in life, *e. g.*, the neck, the legs, especially the lower part, and around the tail, are the toughest, but have the most nutriment and extractives and are the most juicy. These parts are used largely for soups and broths. The parts which have had the least exercise, *i. e.*, the upper portion of the hind quarter and the part lying under the back bone, generally known as the *tenderloin*, are the most tender but the

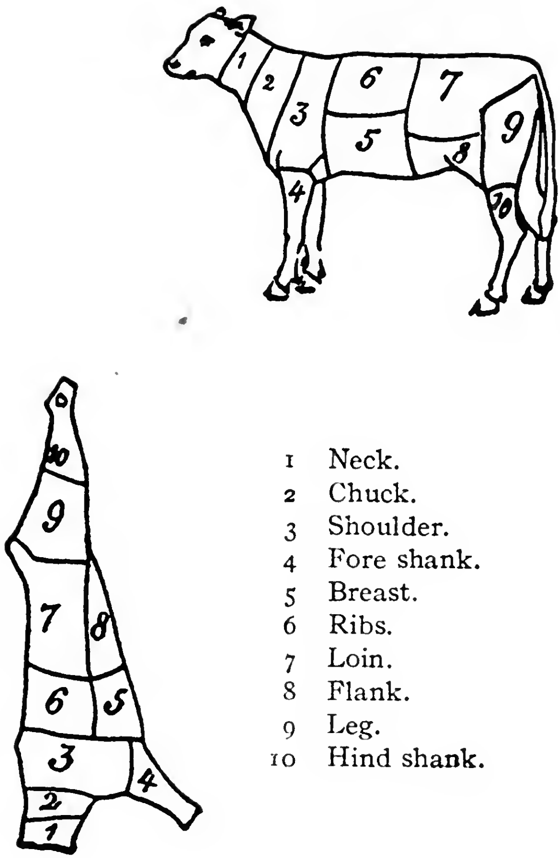
[1] The accompanying diagrams, copied from *Bulletin No. 28*, will give a general idea of the various divisions of meat and their names in different animals, although the names vary considerably in different localities.



1 Neck.
2 Chuck.
3 Ribs.
4 Shoulder clod.
5 Fore shank.
6 Brisket.
7 Cross ribs.
8 Plate.
9 Navel.
10 Loin.
11 Flank.
12 Rump.
13 Round.
14 Second-cut round.
15 Hind shank.

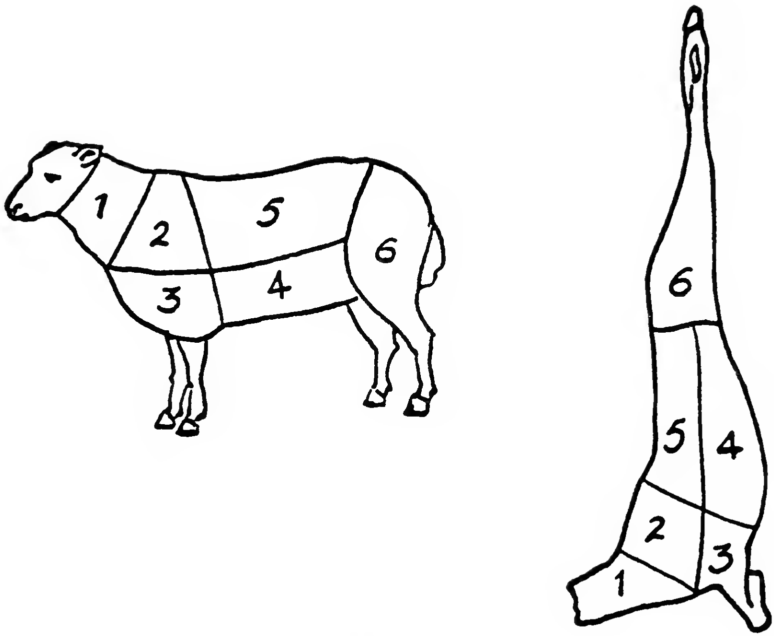


Cuts of Beef



1 Neck.
2 Chuck.
3 Shoulder.
4 Fore shank.
5 Breast.
6 Ribs.
7 Loin.
8 Flank.
9 Leg.
10 Hind shank.

Cuts of Veal



1 Neck.
2 Chuck.
3 Shoulder.
4 Flank.
5 Loin.
6 Leg.

Cuts of Lamb and Mutton

least juicy. The cuts obtained from these portions make the best roasts and steaks. The intermediary portions are more nutritious, but not as tender as the upper part of the hind quarter, and are used chiefly for braising, pot-roasts, and stews. First-class cuts, *i. e.*, the tenderloin and those from the upper portion of the hind quarter, will be improved if, just before serving, juice extracted from the neck or round is poured over them.

Digestibility.—Meat induces the secretion of a comparatively large amount of gastric juice rich in ferments, but it does not require much mechanical effort on the part of the stomach, for, under the influence of the pepsin and the hydrochloric acid, meat, by chemical action, is readily reduced to a soft and somewhat liquid mass. The time required for this varies with different meats and the manner of cooking—*e. g.*, it has been found, by feeding subjects with certain amounts of different kinds of meat and later performing lavage, that raw beef scraped, so that it is freed from all connective tissue, will completely leave the stomach in about two hours, while an equal amount of pork, similarly treated, will only do so in about 3½ hours, and roasted beef, underdone, will leave the stomach in about three hours, but it may be four hours or more before that cooked so that the proteins are hardened will have entirely passed into the intestine. Under normal conditions, however, meat is quite thoroughly digested and absorbed; examination of feces showing that,

ordinarily, only about 5 per cent. of the nutrient matter is lost. Veal, pork, and mutton are prone to cause digestive disturbances in some persons: the first, it is thought, on account of the lack of extractives, in consequence of which there is little stimulation to excite the flow of gastric juice; the pork, probably, does so on account of the large amount of fat, for the reasons given on page 94; and mutton, because of the nature of its fat, even though it is not present in large amounts, is sometimes irritating to the stomach.

Effect of Cooking.—As shown in the preceding paragraph, meat scraped from the connective tissue is digested more rapidly than cooked meat, but if meat is properly cooked its connective tissue is softened, and thus proper cooking cannot be said to lessen the digestibility of meat as a whole; certainly it does not do so to any great extent, and it has the advantage of making it more palatable and of killing germs and parasites that may be present.

The methods of cooking will be described in the recipes, but just one point will be mentioned here, being of importance in judging of the nutritive value of meat as compared to its cost. As previously stated, the cuts of meat containing the highest per cent. of nutrient material and of extractives are the least tender, due to their long fibers and the toughness of the connective tissue around the fibers. This toughness can be greatly diminished by long cooking at a comparatively

low temperature, and it will be much increased by a temperature as high as can be used for roasting and broiling the more tender cuts.

Dietetic Value of Meat.—Meat is about the most expensive of the foods, even the least expensive cuts, since they require to be cooked for a long time, are relatively costly, unless the fuel used for their cooking is, at the same time, being used for other necessary purposes or unless the meat is cooked in a fireless cooker. This method of cooking is advisable, not only as a saving of fuel, but because it affords the means *par excellence* of making tough meat tender. The principal dietetic values of meat are: (1) It furnishes the body with an easily digested form of protein that is particularly suitable, on account of the nature of its amino acids, for building and repairing the tissues of the body. (2) Meat seems to have a general stimulating effect upon the body. (3) It satisfies the hunger for a longer length of time than most foods, but, nevertheless, a man cannot perform a greater amount of labor on an exclusive meat diet, for it has not a higher fuel value than other foods containing the same proportions of fat and protein.

Preservation of Meat—Meat is preserved in cold storage and by drying, smoking, pickling, and canning. Smoking, drying, and pickling tend to harden the fibers of meat, and thus that preserved in any of these ways is not quite as easily digested as fresh meat.

Special Characteristics of the Various Kinds of Meat

Beef.—This is generally considered one of the most nutritious of the meats and it is richer in extractives than white meats. The best beef is obtained from a four- to six-year-old steer, and stall- or grain-fed animals are considered better than grass-fed, as the flesh is made more rapidly and the lack of exercise makes it more tender. Good beef is firm, fine grained, well mottled with fat, and, upon exposure to the air after being cut, is a bright red color and looks juicy. It should have but slight odor, and that should be pleasant, becoming savory on heating. The fat should be light straw-coloured and firm. Poor beef is coarse and flabby and does not look bright and juicy. Dark streaks through the meat show that the blood was not sufficiently drained off when the animal was killed.

Veal.—Although veal may be obtained throughout the year it is of best quality in the spring and summer. The finest veal is obtained from a calf six to ten weeks old that has been fed on milk. Grass-fed veal is poorest. In France, if they desire an especially fine quality of veal, they will often feed raw eggs to the calf for a week or so before it is killed. A calf less than a month old has soft, flabby flesh with a bluish watery appearance. It is known as "bob veal" and it often causes digestive disturbances. Its sale is illegal in some States. Good veal is fine-grained,

tender, and of a pinkish color, with clear, firm, white fat. The upper part of the leg is the most valuable part of the animal and from it the cutlets are taken. The lower part of the leg is known as the knuckle and is used for soups. The other cuts are used largely for roasts, braising, and stewing. Veal contains more gelatinous substances than most meats and it is thus particularly good as an addition to soups, but other meats or flavoring matter must be used with it, for it is deficient in extractives and thus in flavor.

Mutton.—The best mutton comes from a sheep three to five years old. When the animal is less than a year old, it is known as lamb. Mutton should be fine-grained, a rich red color, and juicy, with firm, white fat.

In cutting up mutton, if two loins are left together they are called a *saddle*, and when the ribs and loins are left together they are called a *rack*.

Experiments seem to show that mutton and beef are, usually, equally easily digested, except that the fat of mutton does not agree with some persons. This is probably due to its containing a large amount of stearin. The flavor of mutton is due largely to its fat; it has not nearly as much extractive matter as beef.

Lamb.—This can be distinguished from mutton by the small size and pinkish color of the bones, those of mutton being comparatively white. The age of the animal may also be told by the leg

joint, as it is serrated in young animals and round and smooth in older ones. The flesh of lamb, like that of other young animals, is somewhat lacking in flavor and, as it contains a relatively large amount of water it is less nutritious than mutton, but as the fibers are shorter it is likely to be more tender. Mint sauce, pickles, and the like are usually served with lamb to make up for the lack of flavor.

Pork.—This is the flesh of pig. It has a large proportion of fat, even in the lean meat, intermingled with the fibers. For this reason, it is not as easily digested as other meats. Pork should be always well cooked, for the flesh is often infested with a parasite—the *trichina spiralis*—which, unless killed by heat, will produce the very serious disease known as *trichinosis* in those eating the meat.

The ribs and loins of pork are usually sold fresh and the fat portions are salted. The hams and shoulders are often salted or smoked. The flank, when both salted and smoked, is called *bacon*. This treatment makes the fat granular, and when properly cooked it is easily digested. Thus, bacon can be used in quite large quantities when it is desired to increase the fat in the diet.

Internal Organs of Animals Used as Food.—Some of the internal organs of animals are used for food, notably the brain, tongue, heart, kidneys, liver, pancreas, thymus glands, and paunch.

The brain consists largely of fatty material

and lecithin, which is rich in phosphorus. Because of its soft consistency, the brain is rapidly digested, but it is very imperfectly absorbed and therefore it cannot be regarded as a valuable food for invalids.

The tongue of all animals is used for food. The lean meat is tender when firm and plump, but the fat is hard and not easily digested.

The heart resembles ordinary meat in its composition, but it is firmer in texture and therefore, not as easily digested.

The kidneys and liver are very compact organs and, on account of their firm texture, are not easily digested. The liver contains glycogen and must not be included in a diet when carbohydrates are forbidden. The protein of both liver and kidneys is largely nucleoprotein, and thus these glands should not be used by those who have a tendency to conditions associated with the elimination of an unusually large amount of uric acid, as in gout. As these organs are frequently diseased, care should be taken to select only those in healthy condition. The calf's liver and kidneys are usually considered best.

The pancreas and thymus glands of the calf and lamb are sold under the name of sweetbreads. These glands are cellular organs held together by connective tissue. The best sweetbreads are white, plump, and firm. They spoil very quickly because of the ferments they contain and so can

be kept, for any length of time, only in cold storage. Being of loose texture sweetbreads are readily digested. As their protein, like that of kidneys and liver, is chiefly nucleoprotein, they should not be used in the conditions mentioned in the preceding paragraph.

Poultry.—Under this heading are classed the various domestic birds, as chicken, ducks, geese, turkeys, squab, pigeon. Chicken and young turkey, especially the former, are easily digested, as their flesh is in short fibers and, particularly that of the breast, free from intermingled fat. The fibers of the flesh of fowl are longer and tougher, but, by slow cooking, can be rendered tender. The chief distinguishing marks between chicken and fowl are, in the former, the breast bone is pliable, the skin is smoother than that of fowl and tears easily under the wings. A chicken has a larger number of pin-feathers than a fowl, these in the latter being largely replaced by long hairs. These differences also exist between old and young birds of other species, and the best birds are plump and short in proportion to their weight. Squab is another easily digested meat, and pigeon can be rendered so by proper cooking. Ducks and geese contain too much fat for invalid diet.

Pâté de fois gras is prepared from the livers of geese that have been fattened by over-feeding.

Game Birds.—The flesh of game birds, when tender, is easily digested, but being very rich in

extractives it must be used with caution when highly seasoned food is to be avoided.

Gelatinoids and Gelatin

The gelatinoids obtained from animals are the ossein of bone, the collagen of connective tissue, and the chondrin of cartilage. It is from these that gelatin is prepared. In the manufacture of gelatin, the first crude product is glue, but this, if purified, yields the gelatin of commerce.

Simply boiling collagen in water will convert it into gelatin, which is why soup stock jellies. The connective tissues of young animals is particularly rich in gelatinoids, and calves' feet when boiled will yield an especially pure jelly. An even purer form of gelatin is that known as *isinglass;* this is obtained from the swim-bladder of fish, especially the sturgeon.

When gelatin is allowed to stand in cold water, it absorbs the water and swells; it is then said to be hydrated. Gelatin is not, however, soluble in cold water, but, especially after hydration, it is readily soluble in boiling water. After being dissolved, it will, even in a 1 per cent. solution, cause the liquid to solidify. This is then known as *jelly*. Gelatin is decomposed by prolonged exposure to a high temperature, and thus if a solution of it is boiled for any length of time it will not solidify.

Digestibility.—Gelatin is very easily and quickly

digested and in the stomach it will unite with a large amount of acid; thus it is a particularly valuable article of diet in gastric hyperacidity.

Nutritive Value.—Although gelatin is a nitrogenous food, it does not contain all the amino acids necessary for life and tissue building, and thus it cannot be used as a substitute for other proteins, though, as it contains some of the required amino acids, it will prevent the destruction of the other proteins in metabolism to a greater extent than fats and carbohydrates. It has the same fuel value as other proteins and carbohydrates, but since it takes only about one ounce of gelatin to solidify a quart of liquid little of the nutrient value of jellies is derived from the gelatin. Thus, under ordinary circumstances, the chief value of gelatin is that it affords a means of furnishing a variety of delicate and easily digested foods.

CHAPTER VII

FISH

Classes of Fish—Means of Distinguishing—When in Season—Signs of Freshness—Methods of Preserving—Digestibility—Composition—Nutritive Value—Mollusks—Crustaceans.

Classes of Fish.—There are two distinct classes of fish, the scaly or vertebrate and the shellfish; the latter include the mollusks and crustaceans. The scaly fish may be classed as "fat" and "lean." The fat or oily fish have the fat distributed through the body and the flesh is therefore a dark color, as in bluefish, salmon, mackerel, shad, herring, eels, etc.; the lean or white fish have little fat except in the liver and the flesh is white, as in cod, haddock, halibut, flounder, smelt, whitefish, etc.

Means of Distinguishing Some Fish, and When in Season.—Many kinds of fish may be easily recognized by their markings. The bluefish, haddock, and cod all have lateral lines; those of the cod and bluefish are white, and those of the haddock black.

Some fish may be obtained throughout the

year, but others are used only at certain times when they are said to be *in season*. The reason for this varies: with some fish, it is because their flavor is not good at certain times, as during spawning; while others are not to be had during certain seasons either because they disappear into the deeper parts of the ocean, or because their catching is prohibited by law, except during specified months, in order to preserve the species.

Anchovy is a small fish that is used chiefly, either pickled, or in the form of paste, as an *appetizer*.

Bluefish, also called snapper and greenfish, gets its name from its color. Season, May to October.

Cod has a white skin mottled with gray; it is particularly distinguished by the two white lateral lines which extend the entire length of its body. The flesh of cod being of a coarse fiber it is harder to digest than other white fish. Season, all the year.

Haddock is somewhat like cod in appearance, but is smaller and the lateral lines are black. Season, all the year.

Halibut belongs to the flatfish family; its skin is white on the under side and gray on the upper, average weight fifteen to twenty-five pounds. Season, all the year.

Herring is a fish that is much used either salted, pickled, or smoked. "Bloaters" are herrings that are first salted and dried and then smoked. "Kip-

pered" herring are soaked in brine for a time and then smoked.

Flounder is a small flatfish, dark on the upper and light on the under side. The eyes are both on the dark side. Season, all the year.

Mackerel: the common mackerel is blue covered with dark wavy stripes; its average weight is one to two pounds. Season, May to October. The Spanish mackerel is larger and is silvery blue in color. Season, all the year.

The *tuna fish* belongs to the mackerel family. The flesh of the tuna is firm and of delicate flavor. It is particularly suited for canning and is much sold in this form.

Salmon can be easily distinguished by its pinkish flesh. Season, May to September, but frozen salmon can be obtained the greater part of the year.

Sardines are small fish of delicate flavor, that are used fresh and also, after being cleaned and cooked, are sterilized in oil and sealed in sterile cans. They are also preserved in other ways, as in mustard or in ketchup.

Shad has a silvery hue and is mottled with blue dots. The dots are larger and bluer near the backbone and they are more conspicuous on the roe than on the jack shad. The roe of shad is considered a great delicacy. Season, February to May.

Sturgeon has no scales. Its roe when salted is known as caviar. Season, April to September.

Trout vary greatly in size and appearance; brook trout are the smallest, lake trout the largest. Salmon trout is the name given to those caught in New York lakes. Season, April to August.

Turbot are somewhat like halibut, but are smaller and have a more delicate flavor. Season, October to May.

Signs of Fresh Fish.—The eyes are bright and protruding, the scales bright, the fins and tail stiff, the flesh firm, and there is no disagreeable odor. The last two are the important signs to consider in buying fish, for the others disappear soon after the fish is taken from the water, and though the flavor of the fish is finer while these conditions are present, their absence, so long as the fish is firm and there is no disagreeable odor, does not indicate that the fish is not sufficiently fresh for use.

A relatively thick fish is better than a long narrow one. Those without scales, with the exception of the cartilaginous fish, such as sturgeon, are apt to be tough.

Preservation of Fish.—The keeping qualities of fish are greater if the fish is killed as soon as taken from the water. Fish should be kept in a cold place, closely covered, and away from other food, as they impart flavor to any other food in their vicinity. Fish that are to be kept for any length of time are often frozen and kept in cold storage. They must be cooked as soon as thawed. Other methods of preserving fish

are by drying, salting, smoking, pickling, and canning. The fish most commonly preserved are cod, mackerel, herring, haddock (finnan haddie), and salmon. Preserving hardens the fibers of fish and makes them less digestible.

Digestibility.—Experiments have shown that the white fish, with the exception of cod, owing to the absence of fat in their flesh, are more easily and completely digested than the oily fish. White fish are therefore particularly suitable for invalids and people whose digestion is impaired, or those leading a sedentary life. Fish, especially when eaten in large amounts, will, in some persons, produce skin eruptions.

Nutritive Value of Fish.—Fish is similar in composition to meat but generally contains less fat and more water. Prof. Atwater in comparing the nutritive value of fish with meat says "that the only considerable difference in the two is in the proportion of water and fat present, the flesh of fish having water where meat has fat." As the nutritive value of fish depends upon the amount of fat and protein which they contain, white fish, though easily digested, have not a high nutritive value. A considerable proportion of the protein of fish consists of gelatinoids; compared to meat, fish contain but a small amount of extractives and only a fair proportion of salts. Formerly, fish were supposed to be a good *brain food* owing to a large proportion of phosphorus, but in reality fish do not contain

as much phosphorus as some meats, and the only advantage they have, in this respect, over meat is that some fish, being more easily digested than meat, cause less blood to be drawn to the stomach and, therefore, the brain does not become so anemic and is more ready for work.

In considering the relative value of one fish with another the cost and amount of waste must be taken into consideration, and it will be often found that the cheapest fish is not the one bought for the least money.

Shellfish

The mollusks most commonly used for food are oysters, clams, and scallops.

Oysters.—The oyster is the one most largely used for the sick. Oysters are in season from September to May. When in the shell they may be bought by the dozen or peck, and when removed from the shell, by the quart. Oysters grow in shallow water all along the Atlantic coast. They should never be taken from beds where they would receive the sewage from a city, for it is in this way that they become contaminated with typhoid and other germs. The Blue Points, which are small and plump, are considered the finest variety for serving raw. They came originally from Blue Point, Long Island, hence the name. The larger varieties are better for frying and broiling.

Each oyster is made up of a tough muscle which fastens it to the shell, and a soft body which is made up largely of liver. The oyster is one of the few animal foods which contain the five food principles, the carbohydrate being in the form of glycogen (animal starch). This limits the use of oysters for diabetic patients, though, especially raw oysters, being readily digested, they are much used in invalid dietary.

In cooking oysters, care should be taken to keep the temperature below the boiling point to prevent the toughening of the protein, which would lessen their digestibility. The nutritive value of oysters is low. It would take fourteen of them to contain as much nourishment as one egg, and two hundred and twenty-three to equal a pound of beef.[1] The green color in some oysters may be due to seaweeds or infusoria that were present in the water in which the oysters were grown, or it may be due to copper absorbed by the oysters from the water. The copper is sometimes placed in the water purposely to produce this coloring in the oysters, in order to make them resemble those fed on a special seaweed which is thought to improve their flavor.

Several outbreaks of typhoid fever have been traced to oysters that have grown in beds situated near the effluents of sewers.

Clams.—Clams, a popular article of diet, are of two varieties, soft and hard shell. The soft

[1] *Food and Dietetics*, p. 82. Hutchinson. Wm. Wood & Co.

shell clams are found chiefly along the New England coast, and the hard shell, known as *quahaugs*, are found along the coast to Florida. Small quahaugs are called "little neck clams" and take the place of Blue Points when they are out of season. Clams may be obtained throughout the year.

The clam has a tougher muscle than the oyster and when cooked is harder to digest.

Scallops.—Scallops as seen in the market are the muscles of the fish and are the only edible portion. They are not easily enough digested to be used for invalids. They are in season from October to May.

The Crustaceans.—The Crustaceans most commonly used are the lobster, crab, and shrimp. They are not easily digested and so are not generally a part of an invalid's diet.

Lobsters.—Lobsters are found in deep water all along the Atlantic coast. They may be obtained throughout the year but are most abundant from June to September. The sale of lobsters less than ten inches in length is prohibited by law. A good lobster is heavy in proportion to its size, and, when uncurled, the tail will fly back into place.

The flesh of lobsters is naturally black or dark green, but it becomes red upon boiling. Its fibers are dense and coarse and salts of ammonia may be present. The liver contains considerable fat, and, occasionally, substances that act as

irritant poisons to those eating the fish. For all of these reasons, lobsters are apt to cause serious digestive disturbances. The use of vinegar with lobster is said to lessen the possibility of such disorders.

Crabs.—The crab is found all along the Atlantic coast. Its structure is much like that of the lobster. It sheds its shell and if caught before the new shell has had time to harden is known as "soft shell crab." Crabs are in season during the spring and summer months.

The flesh of the crab, like that of the lobster, is coarse-fibered and so not very digestible.

Shrimps.—Shrimps are not as commonly used in this country as in France and England. Those found in our markets are obtained from Southern waters. They are very small, being only two or three inches long. When taken from the water they have a thin grayish coloured shell which becomes pink when cooked. Season, May to October.

CHAPTER VIII

EGGS

Composition—Tests for Freshness—Preservation—Digestibility—Nutritive Value—Desiccated Eggs—Egg Substitutes.

Composition.—The white of egg consists of water, protein, and salts. The protein of egg white is usually spoken of as albumin, but, while chiefly albumin, it is, in reality, a mixture of proteins—albumins, globulins, and glycoproteins. The mineral matter is largely chlorids and sulphates, but there are also calcium, iron, and phosphates, though in much smaller quantities than in the yolk.

The composition of egg yolk is very complex. It contains protein—chiefly that known as vitellin, which is similar in composition to the caseinogen of milk—lecithin, cholesterin, fats, coloring matter, and mineral matter. The latter includes phosphates, calcium, and iron that are in chemical combination with organic matter and are, by reason of this combination, of special importance in nutrition. In fact, as might naturally be expected, seeing that egg yolk furnishes the matter

necessary for the development of the young chick, there is no other food, except milk, so rich in material suitable for tissue building. Eggs, however, are deficient in energy material as they contain practically no carbohydrate; this not being needed by the chick until it leaves the shell.

Signs of a Fresh Egg.—(1) The shell of a freshly laid egg is slightly rough. (2) If held to the light a fresh egg will appear translucent, with no spot visible. (3) A fresh egg will sink in salt water, an indifferent one will float, and a bad one will float even in fresh water. This difference in the weight of eggs is due to two causes: (1) To the loss of water by evaporation through the shell. The water is replaced by air, but air is lighter than water. (2) To the decomposition of the organic matter of the egg and consequent formation of sulphureted hydrogen and other gases due to the action of putrefactive bacteria which enter the shell with the air.

Preservation of Eggs.—Eggs are preserved by keeping them at a temperature below that in which bacteria can develop (35–40° F.), as in cold storage, and by the exclusion of air. The following are the common methods of excluding air: (1) Packing the eggs in some substance which will pack tightly, which is an antiseptic or, at least, of a nature unfavorable for germ development, and which will not impart a flavor to the eggs. Salt answers these requirements better than anything else. Bran and sawdust

are often used and answer the purpose if kept in a very dry place, but if they become moist they may flavor the eggs. (2) Coating the shell with grease. Fats with a strong odor, like lard, should not be used. (3) Immersing the eggs in a solution of sodium or potassium silicate (water glass) or of lime. The former is best, as the lime imparts flavor to the eggs and interferes with the coagulating properties of the albumin.

To prepare the water glass solution, dissolve one part of the silicate in twenty parts of water which has been boiled and cooled. Before boiling an egg that has been preserved in this way a small puncture should be made in the shell; otherwise, as the solution closes the pores of the shell, it will break as soon as the heat expands the air in the egg. Eggs should always be packed small end down. Only perfectly fresh eggs and those with clean shells should be used.

Digestibility.—There has been a considerable difference of opinion regarding the relative digestibility of raw and soft-cooked eggs, but, by feeding subjects with eggs and washing out the stomach after different periods of time, it has been found that two raw eggs will have only left the stomach after about 2¼ hours while two very soft cooked ones will have disappeared in about 1¾ hours. It has been found also that raw egg undergoes very little digestion in the stomach, probably because, being very bland, it does not produce enough irritation in the stomach to

induce a flow of gastric juice, but, that nevertheless, it is as completely digested in the intestine as cooked eggs, there being no more residue of raw egg in the feces than of soft cooked egg. Thus, the raw egg, being non-irritant to the stomach and calling for no effort on the part of that organ, might be preferred to the soft cooked egg in irritated conditions of the stomach, even though the latter is more rapidly digested. The degree of digestibility of cooked eggs depends on the manner of cooking. Soft cooked eggs are digested more easily than those cooked hard, and hard cooked more easily than medium. If properly cooked (see Recipes), the yolk of a hard egg is mealy and easily crumbled, and can be thus readily acted upon by the digestive juices. Although the yolk is more nutritious than the white, the fat contained in it renders it harder to digest; the white can therefore often be used in illness when the yolk would be deleterious. The presence of sulphur in eggs prohibits their use when there is flatulence, for gases, sulphureted hydrogen and others, may be formed from it.

Nutritive Value of Eggs.—Unless sold at twenty cents a dozen, eggs are an expensive food, as it will take nearly a dozen eggs to furnish the same amount of nutriment as a pound of beefsteak. But, owing to their iron and other salts and the ease with which they are digested, they form a very important item of diet especially for children

and the sick. Eggs are also valuable in cooking both to add extra nutriment and to improve the general quality and flavor of foods.

Desiccated Eggs.—Desiccated eggs are prepared by evaporating the water from the edible portion and thus reducing them to powder. They are much used by bakers and on camping expeditions.

Egg Substitutes.—There are many egg substitutes on the market. Some are manufactured from skimmed milk, others from various forms of starch, albumin, and fat. They nearly all contain baking-powder. Although some of these egg substitutes contain approximately the same food principles as eggs they cannot in any respect adequately replace them.

CHAPTER IX

MILK AND MILK DERIVATIVES

Composition — Digestibility — Nutritive Value — Causes of Spoiling—Methods of Preserving.

Milk

ONLY cow's milk will be considered here; for comparison of this with human milk see Chapter XIII.

Constituents.—Cow's milk consists of about 87 per cent. water holding in solution proteins, carbohydrates, fat, and mineral matter.

TABLE SHOWING THE RELATIVE QUANTITY OF MILK CONSTITUENTS

Water		87 –88	per cent.
Protein	Caseinogen 3	3.50– 4	" "
	Lactalbumin 0.50		
Sugar		4 – 5	" "
Fat		3.5 – 4.5	" "
Mineral matter		0.7 –	" "

The **proteins of milk,** as shown in the above table, are caseinogen and lactalbumin.

Caseinogen, which constitutes about six-sevenths of the total proteins of cow's milk, is a phosphoprotein. It is held in solution because

of its combination with phosphates of lime. If acids are added to, or developed in, milk they combine with the phosphate salts, and the caseinogen is then thrown out of solution, generally as a flocculent precipitate. If rennin is added to milk, as occurs in the stomach, the ferment causes changes in the caseinogen which transforms it into a solid substance known as *casein*. The nature of the changes that occur is not definitely known. If milk is heated, its clotting is retarded or prevented. Why this is so is not positively understood, but it is thought probably that the heat results in change of the lime salts and that for clotting it is essential that these be combined with the caseinogen in the normal manner. This supposition is based on the fact that, if the lime salts are removed, the milk does not clot.

The **lactalbumin** constitutes but one-seventh of the protein of cow's milk. It is not clotted by rennin nor curded by acid, but it is coagulated by heat, and some of the coagulum appears as a scum on the top of milk when it is heated above 170° C. There will be in the scum also some of the caseinogen, which has been freed from the phosphate of lime by the heat, and small amounts of sugar, fat, and mineral matter.

The **fat of milk** is an especially fine emulsion, *i. e.*, it is held suspended in the milk in very small drops. As the milk stands, these drops run together and, fat being lighter than water, rise together to the top of the milk. This is known

as *cream.* Cream, however, as will be seen later, does not consist only of fat.

The **carbohydrate of milk** is lactose or sugar of milk, the nature of which has been already discussed.

The **mineral matter of milk** consists largely of phosphates of lime, which are needed for the bones, especially in growing animals, and phosphates of potash, which are essential for muscle tissue. Other important mineral constituents are iron and citrates. The iron is present in very small quantities, but it is in a particularly assimilable form. The citrates are thought to be of value in helping to prevent a condition resembling scurvy, from which infants fed on condensed and sterilized milks often suffer. These salts, like others, undergo change when the milk is boiled.

Digestibility.—It will be about two and one-half hours before a glass, and from three to three and one-half hours before a pint, of milk will have left the stomach. This is a shorter time than is required for the majority of solid foods to undergo gastric digestion, and milk, as it is clotted in the stomach, is to be regarded as a solid food.

A high degree of gastric acidity will interfere with the digestion of milk, for the acid converts the clot into a tough, hard mass that is not easily penetrated by the gastric juice and which thus may resist digestion for a considerable time. As some people, even in health, have an unusual

quantity of acid in their gastric juice, it is thought that this may account for the digestive disturbances that some individuals almost invariably suffer from after drinking milk.

In spite of this action of acid on milk in the stomach, milk, when means are taken to prevent the formation of too firm a clot, is often a valuable food when there is hyperacidity of the gastric juice because: (1) it does not induce the secretion of acids and ferments to the extent that other foods containing an equal amount of protein do; (2) its protein unites with the acid; (3) the large amount of salts present in milk helps to neutralize the acid. The means commonly taken to prevent the formation of a hard curd will be discussed later.

Absorption.—Taken separately, the various constituents of milk are very rapidly and completely absorbed, but when they are combined as in whole milk, the degree to which they are absorbed varies considerably. Especially in adults, digestion and absorption are much more complete when milk is taken with other food, particularly that containing a considerable quantity of carbohydrates as bread, cracker, cereals. Young children seem to be able to absorb milk to a much greater extent than adults. This, it is supposed, may be due to the fact, that, as the system in youth has a larger requirement for lime salts, these are used up and absorbed to a greater extent than in later life. This facilitates the absorption of the

other milk constituents, because when the lime is not absorbed, it reacts with the fats in the intestine forming insoluble lime soaps which are not readily absorbed and interfere with the absorption of other substances.

Nutritive Value.—Milk furnishes the sole sustenance for young animals for a period of time which, though it varies in different species, is that during which growth, though not muscular activity, is greatest. The milk of each species must, therefore, of necessity, contain all the material that is necessary for growth and the maintenance of life during this period. As growth and muscular activity increase, more concentrated food is required, because the high water-content of milk would render it necessary to take it in too large amounts to get sufficient nutrient. Nevertheless, because of its lime content, its antiscorbutic qualities, and its particularly good building material, milk should form a large portion of the diet during childhood.

Also, during and following illness, milk is generally a useful article of diet, both, because of its value as a tissue builder and because, not requiring mastication nor inducing digestive secretions rich in ferments, it does not use as much energy for digestion as do the majority of solid foods. As milk lacks substances which give rise to uric acid, it is a valuable food when there is an excessive amount of this in the system.

Milk is not to be regarded entirely as a beverage,

since in the stomach it is solidified by the action of the renin, before its digestion begins, and, as shown in the table on page 208, its water content is not much greater than many other foods, in fact, it is less than some of the fruits and vegetables.

Milk, especially skimmed milk, as compared to meat and eggs, is a cheap means of providing part of the protein requirement of the diet, for a pint of milk provides as much protein as four eggs and somewhat more than a quarter of a pound of beef of average composition, and it is considerably cheaper than either of these two foods.

Means of Increasing the Digestibility of Milk.— Since it is the formation of a tough clot in the stomach that renders milk difficult to digest, by preventing this, the ease, completeness, and rapidity with which milk will be digested will be much increased. Some of the agents and means used for this purpose are as follows:

(1) Aërated waters, the gases of which keep the particles of casein apart and so prevent the formation of a hard curd.

(2) Barley water, by virtue of its granules and mucilaginous nature accomplishes the same result.

(3) Lime water, by making the reaction of the milk alkaline, neutralizes the acid of the gastric juice and thus prevents toughening of the curd formed by the rennin.

(4) Milk of magnesia acts in the same manner as the lime water.

(5) Pancreatin and sodium bicarbonate, the pancreatin, which is an extract obtained from the pancreas of the hog or ox, predigests the milk. The sodium bicarbonate is used to render the milk alkaline as the ferments of the pancreatin are only active in an alkaline medium. (For methods of peptonizing, see Recipes.)

(6) Precipitating the caseinogen in a fine flocculent curd, which prevents the formation of a clot by the rennin. This can be done by the addition of wine or acid to the milk or by souring the milk or by causing the fermentation of the lactose as in kumyss, matzoon, etc.

(7) Diluting the milk with water, by increasing the dilution of the milk and of the gastric juice, will lessen the toughness of the curd.

(8) Drinking the milk slowly, in sips, helps in the formation of small, instead of large, curds.

Formerly, it was thought that boiling the milk prevented the formation of a hard curd, because, outside the body, this interferes with the clotting of milk by rennin. This, however, is not now thought to be the case, since, outside the body, boiling interferes with clotting by, at any rate to some extent, rendering the lime salts insoluble and the acid of the gastric juice counteracts this effect.

Bacteria in Milk.—It has been demonstrated that in one cubic centimeter of milk, obtained from a healthy cow, in a model dairy, where every precaution is taken against contamination,

there may be as many as 40,000 bacteria, while milk produced under ordinary circumstances will contain many hundred thousands. The bacteria in milk from a model dairy are seldom harmful, and if the milk is treated with aseptic precautions so that the germs will not multiply too rapidly they will probably do no harm beyond, in the course of time, causing the milk to sour. Some authorities even consider the presence of a few non-pathogenic bacteria beneficial as they develop gases in the milk which make it light and give it flavour. But they must not be allowed to multiply, for they will then produce products in the milk which, especially for infants, may be harmful, and there is always the possibility of the presence of pathogenic bacteria, the development of which would make the milk a source of great danger.

Souring of Milk.—The acid developed in milk which causes it to become sour is known as *lactic acid* and it is produced by the splitting up of the lactose by the agency of certain bacteria, especially the *bacterium acidi lacti*. The dietetic value of this acid was discussed in the section on organic acids. That milk sours more rapidly in warm weather than cold is due to the fact that it is the harder to maintain it at a temperature unfavorable to the development of bacteria, *i. e.*, 40° F.

Care of Milk.—When drawn from the cow milk is about 100° F., a perfect temperature for the development of bacteria; it must therefore be chilled

immediately to 40° F. and it should be kept at that temperature until required for use. Cleanliness is also of primary importance in the care of milk, cleanliness of everything with which the milk will come in contact: the cow's udders, the milker's hands, the milk cans and bottles, etc. The milk cans and bottles should be washed first in cold and then in hot water and sterilized before being filled. The ice-box in which the milk is kept must also be always odorless and clean. Nothing but eggs and butter should be put in the same compartment of the refrigerator as milk and, as cold air falls and the gases to which odors are due rise, these articles should be kept in the lowest compartment or else in direct contact with the ice. As a further prevention against the contamination of milk it should be kept covered. The care required by milk can be summed up in a few words: keep it cold, clean, covered, and away from all substances likely to impart an odor.

Destruction of Bacteria in Milk and Other Means to Prevent Souring.—The legitimate means used for these purposes are: (1) The application of heat; (2) evaporation. The illegitimate means used is the addition of chemicals. Milk so preserved is said to be *adulterated.*

The use of heat for the preservation of milk is known, according to the temperature to which the milk is raised, as *sterilization* or *pasteurization.*

In sterilization the milk is raised to, at least,

boiling point (212° F., 100° C), and this temperature is maintained for from twenty to thirty minutes. At this temperature, the pathogenic bacteria likely to be present in milk are killed and, probably, most of the lactic-acid-forming bacteria. Even at 212° F., however, some of the lactic acid organisms may not be destroyed, and, if it is wanted to keep the milk for any length of time, as during a sea voyage, it is necessary to keep it continuously cold or else to do the sterilizing under pressure so that a temperature of 230° F. (110° C.) can be obtained.

Sterilized milk is not suitable for infant feeding for any length of time, since changes, the nature of which is as yet but imperfectly understood, but that lessen its antiscorbutic properties, occur in milk when it is heated to a temperature above about 160° F., so that infants depending upon it for nourishment are likely to develop a form of scurvy, rickets, or other condition of malnutrition.

In pasteurization the milk is kept at a temperature below which it has been found such changes occur. The two methods of pasteurization in most common use are known as the *holder method* and the *flash method*. In the holder method, the milk is heated to 145° F. and held at this temperature for thirty minutes; in the flash method, the milk is gradually brought to a temperature of 160° F., the temperature maintained for one minute, and the milk then cooled quickly.

By pasteurization, the pathogenic bacteria

likely to be in milk are destroyed and lactic-acid-forming bacteria rendered temporarily inactive, but these are not all killed and, if the milk is to be kept from souring, it must be cooled as quickly as possible and kept at a temperature below 40° F.

To chill the milk, put the vessel containing it (if it will not be broken by sudden cooling) into cold water and surround it with ice. Let it stand thus until sufficiently cool to put into the ice-box. If the vessel containing the milk is of glass or other breakable material stand it in running lukewarm water and chill the water, by the addition of ice, as quickly as possible without breaking the utensil. *The milk must be kept covered while being both heated and cooled,* in the former instance to prevent the escape of the natural gases which give the milk its flavor and are necessary for its easy digestion, and in the latter, to prevent the entrance of bacteria.

When pasteurizing infants' food it is advisable to put the amount required for each feeding in the twenty-four hours into a separate bottle and plug the opening with non-absorbent cotton or other material which is impervious to germs. The Arnold sterilizer and Freeman's pasteurizer are the two most convenient kinds of apparatus for pasteurizing infants' feeding, but an ordinary vegetable steamer will answer the purpose, or the bottles can be put into a basket and set in a deep saucepan of cold water and the water heated to, and kept at, the required temperature.

In evaporation more or less of the water of milk is driven off. When the water is only partially removed the product is generally known as *condensed* or *evaporated milk* or *cream*. When all the water is evaporated so that the solids of the milk are left in the form of a soluble powder, the product is known as *desiccated milk*.

Milk is condensed by boiling it in a vacuum pan, which, as the name implies, is an appliance from which all air can be removed. As the boiling point of a liquid is lower in a vacuum than in air, there is not as much change made in the milk constituents as when the milk is sterilized by boiling in the air, even though the boiling is continued long enough to kill bacteria. After the milk has been evaporated to the required density, it is at once sealed in sterile cans.

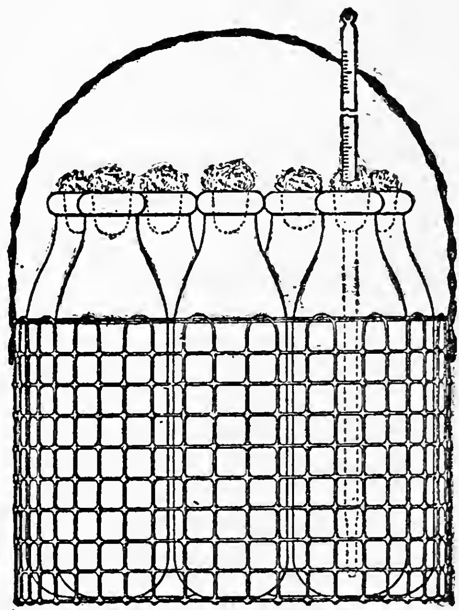


Fig. I. Milk bottles arranged in basket for pasteurization.

Desiccated milk is prepared in several ways. In what has proved about the most successful method, the milk is forced through a spray into

a large heated vacuum oven. The water of the milk is almost instantly evaporated and the solid residue falls as a fine powder to the floor of the oven. This is sealed in sterile jars or cans. When it is required for use, water is added.

Adulteration of Milk.—The more common adulterations of milk are (1) the addition of chemicals: to prevent the milk souring; (2) the removal of cream; (3) the addition of chalk or similar substance to prevent change in the color of the milk by the removal of the cream; (4) the addition of water.

The chemicals most frequently used as preservatives in milk are boric acid and formaldehyd. The use of such preservatives in milk is particularly objectionable, for though, in the small quantities in which they are used, they may not be injurious to healthy adults, this is not true of infants and invalids, especially as these are likely to use a considerable quantity of milk in the twenty-four hours.

Milk Preparations and Derivatives

Junket and Whey.—Junket is the name given to clotted milk that is sweetened and flavored. It contains all the milk constituents, and its food value is increased above that of milk by the sugar and, if wine is used for flavor, as is often the case, by the alcohol.

Whey is the liquid that can be strained from

the precipitate formed by the addition of acid or wine to milk or from the curd produced by rennin. Whey consists of water, lactalbumin, a large portion of the sugar and mineral matter of the milk, and a little of the fat. Its average composition being about as follows:

Water	93.76 per cent.
Protein	0.82 " "
Fat	0.12 " "
Sugar	4.65 " "
Mineral matter	0.65 " "

If whole milk is used for making whey, the fat content may be very slightly increased, being, in such case, about 0.14 per cent., but the clot formed by the rennin is not quite so firm as when skimmed milk is used, and thus it is difficult to obtain the same amount of whey. Both, for this reason, and because skimmed milk is cheaper than whole, it is generally better to use the former.

Cream and Skimmed Milk.—The essential constituent of cream is its fat, but it also contains considerable protein, sugar, and mineral matter, almost as much, in fact, as whole milk, the chief difference in composition between cream and whole milk being in the relative proportions of fat and water. How great this difference is depends upon the quality of the milk and the way in which the cream is separated from it.

In cream, obtained by centrifuge, from an average quality milk (*i. e.*, containing 3½ to 4 per cent. fat) there may be, approximately, 45

per cent. fat, but that obtained from a poor quality milk, even by centrifuge, may contain as little as 25 per cent. fat and less, while that obtained from high grade milk may have as much as 65 per cent. fat. The amount of fat in cream obtained by removing different quantities from the top of milk by skimming can be seen in the table on page 208.

Cream is one of the most easily and completely digested fats.

Skimmed milk contains little fat, how much depending upon the thoroughness with which the cream was removed, but it has rather more protein sugar and mineral matter than whole milk, since cream has somewhat less. Thus, as skimmed milk is sold at a more moderate price than whole milk, it is a cheap means of providing protein.

Skimmed milk seems to be more rapidly digested than whole milk, probably, because fat has a tendency to interfere with the secretion of gastric juice.

Kumyss, Kephir, Matzoon.—These and similar preparations are milks in which lactic-acid fermentation has been produced by different means. As the casein has been precipitated by the acid produced and the milk contains some carbon dioxid, as the result of the fermentation, these preparations are usually more easily digested than plain milk. They, as well as ordinary sour milk and buttermilk, are much used to lessen intestinal putrefaction (see page 38), but it is now considered doubtful if they do so.

Butter and Buttermilk.—Good butter consists of: about 85 per cent. fat, a trace—not more than 1 per cent.—casein, 11 per cent. water, and unless unsalted, 3 per cent. salt. A higher content of casein than 1 per cent. interferes with the keeping quality of butter, as casein, in the presence of as much water as there is ordinarily in butter, readily undergoes decomposition. The water content of butter varies; it is possible to incorporate a considerable quantity during the making, and as an increase in the percentage of water lessens the nutritive value of the butter, more than 16 per cent. is considered an adulteration. Water also interferes with the keeping qualities of butter; if practically all the water is removed, butter can be kept almost indefinitely without becoming rancid.

The fat of butter consists of the simple fats, common to all animal fats, viz., stearin, olein, and palmitin, and, in addition, some glycerids of volatile fatty acids, the principal one of which is butyric acid. It is largely to these acids that butter owes its flavor, and the disagreeable flavor developed when butter becomes rancid is due chiefly to change in these acids by the action of bacteria.

Butter made from cream obtained from the milk of cows fed on dry foods such as are used in winter is of a light hue and is therefore often colored with annatto and even aniline dyes. Annatto and, probably, even the other dyes

generally used are, in small quantities, not injurious to health, but their use has been objected to on the ground that they are used to make butter appear of a better quality than it really is.

Dietetic Value.—Butter is very easily digested and thoroughly absorbed, but, though a valuable food, it is not a cheap one.

Butter Substitutes.—The increasingly high cost of butter has led to the preparation of many substitutes, especially for use in cooking. Some of these, *e. g.*, margarine, oleomargarine, butterine, are made from animal fats, and others, chiefly or entirely from vegetable oils. While these substitutes have not the nice flavor of good butter, they, if sold at a cheaper rate and not passed as butter, are certainly valuable, but margarine and other animal fats can be made to look so much like butter and have been so freely used to adulterate butter, that their use is prohibited in some places.

Renovated or Process Butter.—This is made from butter that has become rancid. The butter is melted in a special apparatus and air is then forced through the liquid to remove the gases giving the disagreeable odor and flavor, and the liquid is then churned with some fresh milk or other butter. The law requires that such butter be labeled *renovated butter.* Such butter may be perfectly safe to use, but there is always a certain amount of risk of the presence of putrefactive products.

Casein Preparations.—Casein freed from other milk constituents is easily digested and rapidly absorbed, and certain preparations of dried casein, *e. g.*, plasmon and protene, are considerably used as a source of protein in the diet during illness. These preparations have the advantage of being almost tasteless and thus they can be given in broth, jellies, etc. They are particularly valuable in digestive disturbances associated with hyperacidity, for the casein unites with acid very readily and will take up even more than meat.

Sanatogen, a considerably used preparation, is a compound of casein and glycerophosphate of sodium.

Cheese.—Cheese may be made from skimmed milk, whole milk, or whole milk and cream, and the richness of the cheese will depend upon the amount of fat left in the curd. The casein is precipitated by the addition of rennet or acid. It is then heated to about 160° F., separated from the whey, salted, and pressed, after which it is put away to ripen for months and sometimes years. In the process of ripening, the bacteria bring about a change by which the casein is partially digested, and also cause a change in its flavor and texture. The variety of flavor is due to the kind of bacteria or mold developed in the cheese, and if a certain flavor is desired a pure culture of that particular kind of bacteria or mold is put into the curd when it is pressed. While many cheeses have what is known as "legiti-

mate or cultivated mold," a mold due to decomposition may have a harmful effect, causing a ptomaine poisoning, known as "tyrotoxicon."

There are about a hundred varieties of cheese and many of them are named from the section where they are made, but as cheese-making becomes more of a science it will be possible, by the use of the proper variety of bacteria or mold, to make the various kinds of cheese in one factory. Until within a few years the majority of the special cheeses were made only in Europe, but at present nearly all the foreign varieties are imitated in America.

Hard cheese is generally made from skimmed milk and is made solid by great pressure. Examples, Young America and Edam.

Soft cheese is made from whole milk or whole milk with the addition of cream. It is a richer cheese and not put under as great pressure as the hard. Examples, Stilton, Limburger, and Brie.

The most common cheeses are:

1. *American.*

A number of the cheeses have no specific name and so are simply designated as American cheese.

Club House, a small cheese of delicate flavor, made from whole milk and cream.

Pineapple, so called from its shape.

Philadelphia Cream, considered one of the best American cream cheese.

Sage, a cheese flavored with sage or substances that will give a somewhat similar flavor.

2. *Belgian.*

Limburger, made from whole milk and cream and flavored with cultivated mold.

3. *English.*

Cheddar, made from whole milk and cream.

Cheshire, similar to Cheddar but with stronger flavor.

Stilton, made from whole milk and cream and flavored with cultivated mold.

4. *French.*

Brie, made from whole milk and cream. There are two varieties, one having blue and the other red mold; the latter is more generally preferred.

Camembert, made from whole milk and flavored with blue mold.

Gruyère, made in both France and Switzerland. There are three grades, the first made from whole milk, the second from milk with part of the cream removed, and the third from skimmed milk. The cheese is full of holes.

Neufchâtel, a cream cheese. It is generally considered the best of its kind in the market.

Roquefort, made from whole milk and cream. When being made, layers of moldy bread crumbs are pressed into the curd and for a year or more it is left to ripen in caves outside the town of Roquefort.

5. *Holland.*

Gonda, much like English Cheddar.

Edam, made from skimmed milk and ripened for a year. It is a hard round cheese, red on the outside.

6. *Italian.*

Gorgonzola, made from whole milk and cream with layers of green mold through it.

Parmesan, made from skimmed goat's milk. The cheese is very hard and is used largely in cooking. It can be bought already grated, in sealed bottles.

Digestion.—As the result of numerous experiments, it has been found that, though cheese requires a somewhat longer time for digestion than many other foods, it is eventually quite as fully digested and does not require any greater expenditure of energy for its digestion and absorption than, for example, meat. Even cooked cheeses, when not overheated, did not seem to be particularly difficult to digest. When cheese is overheated, however, it, like any fatty food similarly treated, will contain decomposed fats and fatty acids which, being irritating, may give rise to digestive disturbances.

Naturally, cheese should not be served, except in very small amounts as a flavor, with other foods that take a relatively long time to digest. Greens, as lettuce, watercress, etc., fruit, crackers, or crisp bread are examples of foods that are appropriate to serve with cheese.

Nutritive Value.—Cheese affords a very compact and concentrated nitrogenous food. Weight for weight, it contains about twice as much protein as meat. Many of the foreign and highly flavored cheeses are expensive and are used only

in small quantities and more especially for their flavor, though, of course, they have a high food value, but the varieties commonly known as *American cheese* are important, not only for their flavor, but because they can be used in comparatively large quantities and, being considerably cheaper than meat and eggs, serve as an economical means of providing protein. Also, such cheese is of value in providing variety in the diet, as it can be served in a number of ways.[1]

Care of Cheese.—Cheese is best kept wrapped in paraffin paper and in a covered jar. A clean moist, not wet, piece of white muslin can be used as a substitute for the paraffin paper.

[1] *Farmers' Bulletin 487* contains a number recipes for cheese dishes and suggestions for its economical use in the diet.

CHAPTER X

PLANT FOODS

General Characteristics, Digestibility and Nutritive Value of Cereals—Vegetables—Fruits—Nuts—Fungi—Algæ and Lichens.

PLANT foods include cereals, vegetables, fruits, nuts, and certain fungi, algæ, and lichens. They contain the same food principles as animal foods, but in different proportions, the common difference being that plant foods contain a larger portion of carbohydrates and less fat and protein than animal foods.

Cereals

Cereals, so-called after Ceres, the goddess of harvests, belong to the grass family and are grown in almost all climates. They are a very important food, some form of grain constituting a considerable portion of human diet in all parts of the world. Wheat is the most used and, probably, rice next; other important ones are Indian corn or maize, barley, oatmeal, and rye. It is from these, especially oats, wheat, and corn that most of the breakfast foods now in use are prepared.

Composition

All cereals are particularly rich **in carbohydrates,** containing, on an average, 65 to 75 per cent. This is chiefly starch, except on the outer surface, of the grain, which is largely cellulose, and serves as a protective covering for the starch grains.

The **protein** content is small compared to that of animal foods, but it is larger than that of the majority of plants. The amount of protein varies, not only in the different cereals, but also in the same kinds grown under different conditions and, more especially, prepared for use in different ways; *e. g.*, rice may contain as much as 9.7 per cent. protein—or polished rice—less than 6 per cent. Oatmeal and wheat contain the largest amounts of protein, averaging, oatmeal 12.2 and wheat 11.0 per cent. The nature, as well as the amount, of protein varies in different grains, the greater part of that of wheat and a considerable, though smaller, portion of that of rye being a tenacious, expansive substance known as *gluten.* It is to the gluten, as will be shown later, that these grains owe their characteristics which allow of their being made into bread.

The proportion of **fat** also varies in different cereals, but is small in all. Oats have the largest amount, from 4 to 8 per cent. Corn may have about 5 per cent., but the other cereals only average about 0.5 to 3 per cent.

The **mineral matter** of cereals is largely in the form of phosphates and lime salts.

Special Characteristics of the Different Cereals

Barley contains more mineral matter, fat, and cellulose than the majority of cereals, but less digestible starch and protein material. The proteins which it does contain are leucosin, proteose, edistin, and hordein. The last is similar to the gliadin of wheat. As barley does not contain gluten, its flour will not make good bread and cake, though, in olden days, it was much used in many parts of Europe and England, instead of wheat flour.

Barley is marketed chiefly in two forms, viz., pearl barley, which is the whole grain stripped of its husk and polished by friction and as a meal or flour.

Barley is valued chiefly for: (1) Its diastase, a ferment which causes the hydrolysis of starch. Malt, which is sprouted and dried barley, owes to this ferment its power of converting starch into sugar, which in turn can be changed into alcohol as previously described. (2) Its demulcent property; this renders barley particularly useful as a diluent of milk for infant feeding, for it helps to prevent the caseinogen forming into a hard curd. (3) Its lime, phosphates, iron, and other salts, which enhance its value in infant feeding.

Buckwheat is a grain from which a dark-colored flour is prepared. This contains enough glutinous material to allow of batter or dough made from it being raised by yeast, though not to such an extent as those made with wheat flour.

Maize or **corn,** of which there are several varieties, is used as a vegetable (*e. g.*, sweet corn); as a breakfast food (*e. g.*, samp, ceraline, hominy, cornflakes); as a meal; as a confection or basis for sweets (pop-corn); as starch, the other constituents of the grains being removed.

The starch, meal, and the various preparations used as breakfast foods are easily digested, and experiments have tended to show that even the corn used as a vegetable, unless the cellulose is over-hardened, as by age, is more thoroughly and easily digested than is generally supposed. Corn contains less protein and mineral matter than some of the cereals, but it has more fat than any of the others except oats, and it has as much digestible carbohydrates as wheat; thus, as it is cheaper than wheat, it affords foods that are nutritious in proportion to their relative cost. Sweet corn contains a considerable, though varying, amount of sugar. Pop-corn contains more water than other cereals and a hard, horny cellulose exterior. It is the resistance of the external coat to the expansion of the water, which occurs when the corn is heated, that causes the corn to pop.

The protein of corn has not the same glutinous

expansive property as wheat, and thus, to make a raised cake or bread, it is necessary to use some wheat flour with the corn meal.

Oatmeal is richer in protein, fats, and minerals than other cereals and, consequently, is more nutritious. It contains such a large proportion of cellulose that it is valuable in the prevention and the treatment of constipation and must be avoided by those suffering from diarrhea and other intestinal disorders. Even when oatmeal gruel and water are strained and the cellulose thus removed, they tend to increase peristalsis, though they have not been found to contain any substance which should have this effect.

Rice is the staple food for about a fourth of the people of the world. It contains less nutriment than the other cereals, except barley, having but a very small percentage of protein, fats, and mineral matter. It is rich in starch, however, and is particularly suited for serving with eggs and milk, as in pudding, or with fish or meat.

Rye is somewhat similar in its composition to wheat, but, though its protein matter contains gliadin, it is deficient in glutenin, the other constituent of the gluten of wheat. As rye contains gliadin, its flour can be used for bread making but, owing to absence of glutenin, the bread is somewhat sticky and porous, also it is of a darker color. If wheat flour is mixed with the rye, a very much nicer bread will result than when the rye is used alone. *Pumpernickel* is a dark, rather

sour-tasting rye bread. Rye is particularly easily malted and fermented, for which reason it is much used as a source of alcoholic drinks. A poisonous fungus, known as *ergot*, that often attacks rye, is used in medicine.

Wheat is one of the most used and most nutritious of the cereals. From it are prepared flour, starch, and a number of breakfast foods, some of the best known of which are grape-nuts, shredded wheat, force, wheat grits, granuto, semolina.

The percentage of constituents in wheat varies considerably according to the variety of wheat and the way in which it is milled or otherwise treated.

If a kernel of wheat is cut into thin slices and examined under the low-power objective of the microscope, three distinct parts will be seen: (1) an outer coat, which is named the *bran;* (2) a mass of cells opposite the rounded end of the kernel, known as the *germ* or *embryo;* (3) the *endosperm.*

The **bran** consists of three distinct layers: the outer one of which is entirely cellulose and mineral matter; the second layer has less cellulose and contains many small cells containing the pigment to which the color of the bran is due; the inner layer has still less cellulose, but considerable mineral matter and a protein substance known as *aleurone.*

The **germ,** which is the embryo from which a new plant can spring, is rich in soluble proteins and fat.

The **endosperm** which is the food stored up by the plant for the use of the germ, will, if examined under the high-power objective, be seen to consist of a fine network of cellulose holding starch grains. In the interstices of the network, especially directly under the bran, are proteins, chiefly a mixture of gliadin and glutenin that is termed *gluten*. The value of flour is greatly influenced by the relative proportion of gliadin and glutenin in the gluten, about twice as much gliadin as glutenin being best for bread flour. The especial value of gluten in cooking lies in its glutinous and expansive qualities, by virtue of which it holds gas, generated as described in the recipes, and expands under its influence, thus making bread, cake, etc., light and porous.

In the preparation of flour, the wheat is cleaned, screened, broken, and crushed and, afterwards, passed through sieves and bolting silk cloths. In the course of preparation, the germ is removed and also varying proportions of bran or cellulose. The germ is removed because it lessens the keeping properties of flour, since its fat easily becomes rancid and its soluble proteins contain a ferment which hydrolyzes starch. The bran is removed because it is difficult to reduce it to the consistency of flour.

Bearing the composition of wheat in mind, it can be easily appreciated that the more thoroughly the cellulose is removed the less protein and

mineral matter will preparations made from this grain contain.

Graham flour and **whole-wheat flours** are those in which much of the finer bran is retained. The term *whole wheat* is a misnomer, however, since such flours contain only part of the bran and, usually, none of the germ.

Hovis flour and **germ flours** are those to which part of the germ is added after it has been sterilized to destroy its ferment and prevent its fat becoming rancid. These flours are richer in protein than ordinary flours.

Gluten flour is that from which some of the starch has been removed. This can be done by kneading the starch in running water. Some so-called *gluten flours* do not deserve the name, as they contain very little less starch than the ordinary flours.

Soy bean flour is made from the soy bean—see under legumes.

Wheat that is sown in spring and harvested in the fall—**spring wheat**—contains more gluten than winter wheat—that sown in the fall—and its flour is best for making bread, while the flour obtained from **winter wheat** has a larger per cent. of starch and is preferred for pastry.

Durum wheat is a variety containing more protein and cellulose than other wheats. It does not make good flour for ordinary purposes, but the great viscidity of its gluten allows of flour made from it being molded in various ways and

thus it is best for making macaroni, vermicelli, and similar pastes.

In the wheat preparations used for breakfast foods a smooth consistency is not required, as for flours, and thus these contain much more, if not the whole, of the kernel.

Digestibility of the Cereals

The degree of digestibility of cereals depends largely upon the amount of cellulose present and the method of preparing the cereal for use. Cellulose, it will be remembered, is not digested in the stomach and only slowly and imperfectly in the intestine; therefore, if the starch is left surrounded by cellulose, it cannot be easily reached by the digestive juices and its digestion will then be retarded and incomplete. For this reason exposure to heat and crushing of the grain (as in the treatment to which shredded wheat, force, and similar preparations are subjected), which free the starch from the cellulose and render the latter somewhat granular, greatly increase the digestibility of cereals. Long-continued boiling is also of value and is necessary for cereals that are not given any preliminary treatment in their preparation for the market.

Even when so treated, cellulose to some extent interferes with the digestion and absorption of other food materials. This is not always a disadvantage, however, as it is a preventive of consti-

pation. Nevertheless, it has to be considered in judging of the actual nutritive value of the cereals.

Dietetic Value.—The cereals are a comparatively cheap food and are easily preserved and prepared for use. Their richness in starch makes them of particular value for combination with food materials rich in protein and fat, elements which they lack. The factors which influence their digestibility, naturally, also affect their nutritive value, since it is only that which is absorbed that nourishes the body, but there are other things to be considered in judging of the value of a food; one of these, the prevention of constipation, was mentioned in the preceding paragraph. Another point is that the complete removal of the cellulose also removes the mineral matter and vitamines, the uses of which have been previously discussed. The loss of these constituents is not of much importance in cases where a generous supply of fruit and vegetables is to be had, but it is when, for economical or other reasons, the amount of food taken is restricted to the actual necessities of the body; this is especially true in the case of children.

Study of feces following diets of different breads have led to the very general opinion that bread made with flour which is of a natural creamy color will probably yield the greatest amount of nutrient and mineral matter to the body, because it contains more of the elements other than starch than white bread and, though it contains

less than the darker breads, as bran and Graham, more of its nutrient material will be absorbed. Notwithstanding this, these other breads, when good, have their special value, and when taken in small amounts with other food more of their nutrient is absorbed than when they constitute a meal.

Though the proteins in the different cereals vary and have not the same value as gluten in cooking, they have about the same nutritive value.

Preservation of Cereals.—Cereals will keep almost indefinitely if kept perfectly dry and in a cool place, but moisture is conducive to molding and must, and heat favor the development of maggots from eggs that are likely to be with the grain.

Vegetables

Vegetables include nearly all plants used for food with the exception of cereals, fruit, and nuts. Different parts of plants are used, the roots of some and the leaves, or pods, or seeds, of others.

Classification.—Vegetables may be classed as:

Legumes or pulses; *e. g.*, peas, beans, lentils, peanuts.

Roots and tubers; *e. g.*, potatoes, turnips, beets, etc.

Green vegetables; *e. g.*, cabbage, lettuce, spinach, etc.

The Legumes

Composition.—Compared with other vegetables, the legumes contain a large amount of protein, which, it will be remembered, is partly prepared by bacteria in nodules that form on the roots of these plants. The greater part of their protein consists of a substance known as *legumin* or *vegetable casein*, the reason for the latter name being that this protein somewhat resembles the casein of milk, though it, especially that in beans, contains more sulphur than casein or, in fact, almost any other protein. Legumin unites with lime salts to form a very insoluble substance. It is for this reason that, unless soft water is used for their cooking, sodium bicarbonate is added to precipitate the salts in the water and thus prevent them combining with the legumin. The legumes also contain considerable carbohydrate—in the form of cellulose and starch—and mineral matter, but they are poor in fat, for which reason, they are well served with fatty foods as pork, bacon, and salad dressings.

The soy bean is particularly rich not only in fat but in protein, and contains very little starch; thus a flour made from it is much used in the preparation of food for diabetic patients. Peanuts also can be used by diabetics, being rich in protein and fat and deficient in carbohydrates.

Digestibility.—As ordinarily cooked, the legumins are neither very completely digested nor

absorbed. Except in young children and invalids, this is usually only of importance inasmuch as it lessens the nutritive value of these foods, but when digestion is slow or impaired in any way or constipation exists, and, sometimes, even in normal individuals, the sulphur may cause flatulence by, when freed from the other protein constituents, combining with hydrogen to form sulphureted hydrogen gas. If the cellulose is removed from peas and shelled beans as by cooking them until soft and then passing them through a fine colander, the protein can be easily acted upon by the gastric and other digestive juices and will then be easily digested and absorbed.

Dietetic Value.—Even allowing for loss in digestion, the nutritive value of some legumes is high as compared with that of other vegetables. Owing to their high protein content, they can be used as a substitute for meat, though, as can be seen by the tables, pages 204 to 211, it will require a larger quantity of them than of meat to furnish the amount of protein needed, and, as already stated, more vegetable protein than meat protein is necessary to furnish enough of certain amino acids that are of importance to the body.

Roots and Tubers

The roots and tubers consist very largely of water, the majority of them having a larger amount than milk. Also, they contain: Cellulose

—which constitutes the main part of their framework; small amounts of soluble carbohydrates; mineral matter—which is chiefly salts of potash; very small quantities of fat and nitrogenous substances. The last are mainly the non-protein extractive matter known as *amides*, and it is to these that the flavor of the roots and tubers is chiefly due, but they have otherwise little food value.

Beets contain a larger amount of soluble carbohydrates than the majority of roots and tubers (about 11 per cent.) which is chiefly sugar. Also, they have more cellulose. As this is rendered somewhat soluble by acid, the addition of vinegar to beets allows of their being more fully digested.

Onions are valued chiefly for their pungent oils, which make them useful for flavors. The so-called Spanish onion, which is grown in warm countries, has a milder flavor and more nutrient, than other varieties. All kinds of onions have considerable cellulose and their extractives, unlike those of other vegetables, except asparagus, give rise to uric acid in metabolism.

Parsnips average about 14 per cent. soluble carbohydrate, **carrots** and **salsify** about 10 per cent.; this is partly starch[1] and partly sugar and pectose. The salsify or oyster plant is similar

[1] Starch, though not actually soluble in water, is counted among the soluble carbohydrates of vegetables as it is rendered soluble on cooking and in digestion.

in nature to the parsnip, but it has a more delicate flavor.

Potatoes contain considerable more food material than the other vegetables, as they have on an average about 18.0 per cent. starch, 2.2 per cent. protein, 0.1 per cent. fat, and 1.0 per cent. mineral matter. The starch of potatoes is particularly easily digested and also fermented. On account of the latter characteristics, the use of potatoes is contraindicated in digestive disturbances associated with gastric fermentation and in gastric dilatation. Baked potatoes contain more nutrient matter than boiled, since in boiling, unless the skins are left on, as much as a third of their solid matter may be lost, not only by extraction during cooking, but by peeling, for the largest amount of their protein and salts lies directly under the rind, and the latter can be removed with less loss of underlying material when cooked. Thus there will be much less loss of solid matter if the potatoes are boiled before peeling.

Sweet potatoes are equal to other potatoes in nutritive value, though they have less starch, the deficiency being made good by sugar.

Radishes consist chiefly of cellulose, water, and salts.

Turnips have less than 5 per cent. soluble carbohydrate and it is chiefly in the form of pectose. They also contain cellulose, but no starch or sugar.

Tapioca and **arrowroot,** though not used as

vegetables, belong, botanically, to this class of plants, since the former is a starch prepared from the roots of the *cassava*, a tropical plant, and the latter, a starch obtained from the *maranta arundinacea* and similar plants grown in the East and West Indies. Tapioca and arrowroot are particularly pure forms of starch. Their digestion and nutritive value are the same as other starches.

Digestion and Dietetic Value.—With the exception of the potato, the vegetables classed as roots and tubers have little fuel and less tissue-building value, for not only have they little matter that can be used for such purposes in their composition, but as the little they have is chiefly in the form of soluble carbohydrates which, being soluble in water, will be, as well as some of the salts, dissolved and discarded in the water when it is drained from the vegetables at the completion of cooking. Also, due to their admixture with cellulose, which is never perfectly digested, there is loss in digestion. Thus, their chief value lies in: (1) their salts, which, being largely potash, are of special value in maintaining the alkalinity of the blood; (2) their different flavors, which give variety to the diet; (3) their bulkiness, which acts as *ballast* in the intestine, favoring peristalsis and thus helping to prevent constipation. Potatoes having more starch and other solid matter, and their starch being well absorbed, have a higher nutritive value than the other vegetables of this class. The influence of cooking on their nutritive

value has been already referred to. Their salt content also being high, and the salts of alkaline reaction, they are of special value in neutralizing acids taken into or formed in the system. Due either to their salts or vitamines, these vegetables, more especially potatoes, are valuable as anti-scorbutics.

Preservation.—The roots and tubers can be stored for winter use if kept in a cool, dry place and in bins or barrels to exclude the light. Heat and light cause the vegetables to sprout, which injures their flavor and texture, and dampness favors the development of mold and decay.

Green Vegetables

The vegetables classed under this heading are those of which the leaves and stalks of the plants are used. The best known are: Asparagus, artichokes, Brussels sprouts, cabbage, cauliflower, celery, spinach, dandelion tops and similar greens, lettuce, kale, endive, romain, and chicory. As plants manufacture, but do not store, food material in their leaves, these vegetables contain even less starch, fat, and protein than most of the roots and tubers. They consist chiefly of water, cellulose, and salts. Thus, their value in the diet, even more than that of the latter vegetables, is due to their salts, to their stimulating effect on intestinal peristalsis and to their flavor, which is chiefly due to either essential oils, salts, or amids. Also,

as they are much used with sauces or salad dressings they afford a means of adding fat, etc., to the diet.

Cabbage contains considerable sulphur and thus often causes flatulence, the sulphur uniting with hydrogen to form sulphureted hydrogen gas. Vinegar with cabbage makes it easier to digest, because it tends to soften the cellulose.

Cauliflower belongs to the cabbage family, but is much more easily digested. It does not, as is often supposed, contain more starch than cabbage.

French artichokes, which are used both hot and cold, have their carbohydrate, other than cellulose, in the form of inulin and contain little or no starch or sugar, thus they are of value in diabetic diet.

Cucumber—Egg Plant—Squash—Vegetable Marrow ·Tomato

These, in botany, are classed as fruit, but, in the diet, they are used chiefly as vegetables. Their nutritive value is similar to that of the green vegetables.

Tomatoes are of special value on account of their flavor and of the variety of ways in which they can be served. They contain about 93 per cent. water and 4 per cent. carbohydrate, which includes sucrose, dextrose, and levulose. Also,

they contain citric acid, and thus they should not be used when acids are prohibited.

The substance of cucumbers is fibrous and compact and is thus hard to digest. Vinegar, by its action on the cellulose, makes them somewhat easier of digestion.

Fruit

Composition.—In fruits, as in most vegetables, there is but little protein and fat. They contain more water than any other material and, next to this, cellulose, the stability of their structure being due to the latter. Their other carbohydrates are almost entirely sugars and pectoses, though in certain ones, as the banana, there is a little starch. Fruits are relatively rich in mineral matter, which is largely in the form of potash and their flavor is due to these, to their free acids, and to ethers. Dates, figs, grapes, and raisins have relatively large amounts of iron.

The amount of acids and sugars and the nature of the sugars and cellulose vary in fruit in different stages of unripeness and ripeness. When unripe, they have more cellulose and free acid than when ripe, and the digestive disturbances caused by eating unripe fruit are due to irritation of the stomach and intestines by these substances. The kinds of acids present in different fruits, their action and uses in the body, were discussed under organic acids, in Chapter II. As there

stated, these acids are changed to carbonates after absorption and thus they serve to furnish the system with alkaline substances. The following table, which has been compiled from different sources, shows the average amount of acid in ripe fruit:

Apples	1.0
Apricots	1.0
Bananas	0.0
Cherries	1.0 to 1.5
Cranberries	2.2
Currants	1.5
Gooseberries	1.5
Grapes	0.5
Lemons	7.0
Melons	0.0
Oranges	1.0 to 2.5
Peaches	0.7
Pears	0.1
Plums	1.0
Raspberries	1.4
Strawberries	1.0 to 2.0

The comparative degree of acidity of fruit cannot be determined by the taste, since this is modified by the amount of sugar present.

Some fruits, *e. g.*, apples, pineapples, and apricots, contain considerable sucrose of the nature of cane sugar, but the sugar of the majority of ripe fruits consists of levulose. As this sugar has been found to be more easily assimilated by diabetics than glucose, fruit can be used in somewhat larger amounts by those suffering with this disease, than foods containing the same percentage of carbohydrates in other form.

The nature and action of pectose, the other common carbohydrate of fruit, were discussed in Chapter II.

Dietetic Value.—Due to their cellulose, acids, and salts, fruit tends to act as a laxative in the intestines; this is especially the case with prunes, figs, dates, and apples. Their salts make them valuable antiscorbutics and serve the other uses mentioned in Chapter III. The flavor of fruits makes them an agreeable form of food but, except bananas, dried figs, dates, and prunes, their fuel value is small in proportion to their bulk and their tissue-building value is exceedingly small. Dried fruits that are stewed will not necessarily contain more solids in proportion to their bulk than fresh fruit, since the water they absorb in cooking replaces that lost by drying and there will be a loss of solids if all the liquid in which the fruit is cooked is not used.

Fruit Juices.—These are much used as flavors for jellies, creams, beverages, etc. They have, of course, not quite the nutritive food value as the whole fruit since some of even the soluble solids will remain in the discarded pulp. Thus, the percentage composition of the edible portion of the whole orange is about as follows:

Water	*Protein*	*Cellulose*	*Soluble Carbohydrates*	*Ether Extract*	*Acid*	*Ash*
86.7	0.8	1.5	8.7	0.6	1.0 to 2.5	0.6

and that of orange juice is about:

Water	*Protein*	*Cellulose*	*Soluble Carbohydrates*	*Ether Extract*	*Acid*	*Ash*
85.0	—	—	10.8	0.2	.95 to 1.93	0.3

Many of the fruit flavors sold at soda water fountains and used for flavoring cheap ice creams and confections are combinations of ethers and similar substances obtained from various sources, many of them being synthesized from coal-tar products. While these are probably harmless, they have not the dietetic value of the real juices.

Nuts

By looking at the tables on pages 214 and 220, it will be seen that nuts have, compared to the majority of foods, but little water, a high content of fat, and a moderate amount of protein and mineral matter. Their carbohydrate, with the exception of that of chestnuts, is largely cellulose.

Experiments have shown that when nuts are not eaten in large quantities at a time or at the end of a heavy meal, they are more easily and thoroughly digested than was formerly supposed, especially if they are well masticated or chopped or ground. Nuts and fruit, especially fresh fruit, form a good combination, nuts being deficient in carbohydrate and a very concentrated food,

and ripe fruit containing easily digested carbohydrate and being bulky in proportion to the food value of their contents.

Chestnuts contain a comparatively large amount of starch, and almonds a particularly small amount. A meal prepared from almonds is, as it contains so little starch, used for making bread, cake, and the like for diabetic patients.

Fungi. Algæ. Lichens

The common edible fungi are mushrooms and truffles. They have little nutritive value and are not easily digested, but they give variety to the diet.

Mushrooms.—There are several varieties of poisonous fungi which resemble the mushroom; the chief points of distinction between the two are as follows: The poisonous fungi are brightly colored, have a scaly or spotted surface, flesh that is either tough or watery, and, as a rule, they have a disagreeable odor and grow in damp, shady places. On the other hand, mushrooms are not highly colored—they are generally of a dull red or brown hue,—neither are they scaly nor spotted; they have rather an agreeable smell; their flesh is brittle.

Truffles are generally grown underground. Of the two varieties, black and white, the former is considered the finer.

Algæ and Lichens.—Irish moss, though often

improperly classed as a lichen, is an algæ or seaweed. It is of a mucilaginous nature and is sometimes used in making jellies. Iceland moss is the only edible lichen of importance. It contains a form of starch that does not seem to be affected in the same manner as ordinary varieties in digestion and metabolism and it is therefore sometimes used for making bread for diabetic patients. It is also used for demulcent drinks.

CHAPTER XI

CONDIMENTS

Condiments—Syrups—Honey—Beverages—Nature, Origin, and Food Value of Spices, Flavoring Extracts, and Other Condiments—Of Syrups, Honey, and Beverages in Common Use.

BY a condiment is meant *a substance used with or added to food to improve its flavor.* Sauces, salad dressings, pepper, salt, vinegar, spices, flavoring extracts, and the like are all of this order.

Food Value.—Many of the substances used as condiments have little fuel or tissue-building value but, by improving the odor and flavor of food, they stimulate the nerves of taste and smell and thus, reflexly, excite the secretion of saliva and gastric juice and, thereby, favor digestion; some of them, especially the spices, pepper and mustard, by their irritating action on mucous membranes, improve the circulation of blood in the stomach and intestines and stimulate their motor activity, and in this way also, if not used in excess, they assist in the digestion and absorption of food. In fact, so marked are these properties, that pre-

parations of several of these substances are used in medicine to relieve colic, as counter irritants, and for other similar purposes, and, if they are used in excess, they may produce a chronic congestion of the alimentary mucous membrane and, as they are eliminated by the kidneys, of the urinary organs.

Since children's mucous membranes are much more easily irritated than those of adults, only very small amounts of condiments should be added to their food and the more irritating ones, as pepper and mustard, should not be given them at all. Caution must be also observed in the use of irritating condiments by those suffering with gastric, intestinal, kidney, or bladder disturbances.

In addition to their value as aids to digestion, condiments are of use in that they make it possible to vary the flavor of food and thus they help to prevent sameness in the diet when there is not a great variety of food to be had. Still another value of some of the substances used as condiments, especially salts, spices, and vinegar, is that they have a decided antiseptic action and thus can be used for the preservation of food.

Volatile Oils.—A large number of the flavoring substances owe their flavor to volatile oils or to similar substances known as *ethers*.

The volatile oils, known also as essential oils, were so named because (1) they volatilize at ordi-

nary temperatures; (2) they are the essence or essential part of the flavoring substance in which they are contained.

The chemical composition of these oils resembles that of the camphores and terpenes and allied hydrocarbons.

Many of these oils are extracted from the fruits, seeds, leaves, etc., containing them (usually by pressure or by distillation) and used separately for the flavoring of food, candies, and beverages. The principal essential oils used in this way or as a base for the so-called *flavoring extracts* are: anise, sweet and bitter almond, cinnamon, cloves, fennel, lavender, lemon, orange, peppermint, rose, rosemary, sassafras, spearmint, wintergreen.

Vanilla extract is prepared from vanillin, the active principle of the vanilla bean, which is readily extracted from the dried beans by alcohol. An artificial preparation, with similar flavor as true vanilla and which is sold under the same name, is made by the oxidation of eugenol (a substance obtained from oil of cloves) with potassium permanganate.[1] Also, it and a number of fruit flavors used for syrups, etc., are prepared synthetically from different mixtures of various ethers, aldehyds, alcohols, etc.

[1] By oxidation is meant the union of oxidation with matter. Potassium permanganate parts with some of its oxygen very readily when, under suitable conditions, it is brought in contact with substances having an affinity for oxygen.

Origin and Uses of Some of the Common Condiments

Condiments prepared from the leaves and stems of plants are: Bay leaf, sage, sweet marjorum, summer savory, thyme—these are prepared for use by drying and are used more especially for meat dishes, soups, and stuffing for fowl and meat; parsley, used as a flavor and garnish with meats and vegetables; spearmint, used chiefly, minced in vinegar, with lamb and mutton and its oil is used as a flavor for various beverages, chewing gum, and other confections; sweet basil—the taste of this resembles cloves and it is chiefly used dried, as a flavor for cooked fruit and confections; wintergreen—it is principally the oil, obtained from the leaves, that is used as a flavor for certain beverages and confections.

Condiments obtained from buds and flowers of plants are: Capers, used chiefly as a flavor for meat sauces and in pickles; cloves, used especially for cooked fruit, some preserved meats, and pickles; saffron, the most common use of this is as a yellow coloring for candies and other confections—it has, however, an agreeable flavor.

Condiments prepared from fruit of certain trees and bushes are: Allspice, used in pickles, sauces, confections, cake, and cooked fruit; capsicum or cayenne pepper and paprika, used with meat dishes and sauces and salad dressings; pepper, white and black—these are both prepared from the fruit of the same tree, but the unripe fruit

is used for black pepper and the ripe for white; also there are some differences in the mode of preparation, notably the fermentation of the berry for the white variety. White pepper is less pungent but more aromatic than black, and is usually preferred to the latter for vegetables and vegetable sauces.

From seeds are prepared: Anise, cardamon, caraway seed, coriander seed, cumin seed, fennel, nutmeg, and mace—these are all used more especially for cake and other confections and beverages such as liqueurs and cordials; celery seed, used for vegetables, meats, and sauces; dill, which is used chiefly for pickles; mustard—there are two varieties: (1) the so-called *black mustard*, obtained from the seed of the *Brassica nigra*, and (2) the so-called *white mustard*, prepared from the seeds of the *Brassica alba*. The essential elements of the former are the active principle *sinigrin* and a ferment; those of white mustard are the active principle *sinalbin* and a ferment. When mustard is moistened, the ferment is activated and it decomposes the sinigrin or sinalbin into dextrose and a volatile oil to which the flavor and pungency of the mustard are due. At a temperature of 60° C. (140° F.) the enzyme is destroyed and fails to act—thus, if its full strength is desired, mustard must not be mixed with hot water.

From the bark of trees, of the same names as the condiments, are obtained: Cassia and cinnamon—both of which spices are much used as a

flavor for certain cooked fruits, for pickles, sauces, cake, and the like.

Prepared from roots are: Ginger, used chiefly preserved or candied or in beverages and cakes; horseradish, which is grated, mixed with vinegar and served with meat; sassafras, used principally as a flavor for beverages and confections.

Sodium chlorid, which is one of the most commonly used condiments, is obtained chiefly from salt beds, but also, to some extent, from the ocean and salt springs by evaporation and purification. Sodium chlorid greatly improves the flavor of most cooked foods—in fact, many kinds are very tasteless without it. As a rule, more sodium chlorid is taken with vegetable than with animal foods, and this habit, it is thought, is probably developed, at least in part, out of a physiological need produced by the chemical reaction that occurs between the potassium salts of vegetables and sodium chlorid, in which the salts interact to form potassium chlorid and sodium phosphate, thus depriving the body of sodium chlorid. If used in excess, sodium chlorid will be harmful, especially to the kidneys through which it is eliminated; taken in very large amounts, it has even caused death. For reasons that will be found in the section on nephritis, sodium chlorid is withheld from the diet when there is any tendency to edema.

Vinegar is made from alcohol by a fermentation brought about by a fungus known as *mycoderma aceti* or *mother of vinegar*. The best vinegars are

made from wine, cider, and malt, but vinegar is also made from glucose, cane sugar, molasses—in fact, from anything that readily will undergo a fermentation which will *give rise* to an alcohol that, upon oxidation, will yield acetic acid. It may be also made from wood, by destructive distillation, but *wood vinegar* is not allowed to be sold in the United States. The principle of vinegar is acetic acid, of which good vinegar contains about 6 per cent.

Molasses and Syrups

Molasses or treacle, as it is often called, is a preparation of the liquid residue of syrup that has been concentrated by boiling until the greatest part of its crystallizable sugar content crystallized and was removed. Molasses contains some sucrose, the non-crystallizable sugars—glucose and levulose,—some mineral matter, and minute traces of organic matter other than sugars.

A good syrup is the refined saccharin substance obtained from the sugar cane, maple sugar tree, etc., from which no sugar has been removed. Poor grades of syrup, however, are flavored glucose solutions or mixtures of molasses, glucose solutions, and syrups. According to the Pure Food Law, it is illegal to sell such syrups unless the nature of the mixture is stated on the label. The objections to the use of much manufactured glucose were stated in the section giving the characteristics of glucose.

Sorghum syrup is the saccharin juice of the sorghum or Chinese sugar cane. This cane is now grown in many of the Southern and Middle West States.

Honey

Honey is a sweet viscid liquid obtained by bees, chiefly from the nectaries of flowers (*i. e.*, those parts of flowers specially constructed for the elaboration of honey). After transportation to the hive in the proventriculus or crop of the insect, it is discharged by them into the cells prepared for its reception; whether the nectar undergoes any alteration within the crop of the bee or not is a point that has not been decided.

Honey consists chiefly of invert sugar (*i. e.*, glucose and levulose in equal proportions), about 75 per cent., and a small amount of sucrose and mineral matter and water. Its taste varies somewhat, being influenced by the species of plants from which the bees extracted the material.

Honey is sold (1) in the comb and (2) after extraction from the comb, by means of special centrifugal machines; this is known as *strained* or *extracted honey*. Comb honey is not easily adulterated, but the strained honey has been and still is subject to adulteration with cheap syrups and glucose, though, since the enactment of the Pure Food Law, such adulteration is less common.

Beverages

The majority of beverages in common use may be classified as:

(1) Milk and milk products.
(2) Caffein beverages.
(3) Coffee and tea substitutes.
(4) Theobromin beverages.
(5) Alcoholic beverages.
(6) Unfermented fruit juices.
(7) Waters.

Allied to beverages, though not classified as such, are soups and broths.

Milk and milk products have been already described; these, as already shown, are to be considered as foods as well as beverages.

Caffein Beverages

The principal beverages coming under this class are coffee and tea. Also, there are now various preparations containing caffein used as flavors with carbonated waters—*e. g.*, coca-cola and, in some countries, caffein-containing material that is used for beverages are obtained from plants other than the trees and shrubs from which the ordinary coffees and teas are derived. The natives of many lands from very early times have known of indigenous plants from which stimulating drinks

containing caffein or similar substance could be prepared.

Nature of Caffein.—Caffein is an alkaloid of similar chemical composition to the purin bodies which constitute a large portion of the extractives of meat.

Origin of Coffee.—Coffee is obtained from the coffee berry, that develops on a tree of which there are several species in various tropical countries.

The true Mocha coffee, which comes from Yemen, a district in Arabia, and Java, which comes from the island of the same name, are considered to be about the best coffees, but most of those now sold under these names come from South America and may or may not be good.

Constituents of Coffee.—The principal constituents of coffee are: caffein; caffeol, a volatile oil developed in the roasting of coffee, to which the odor and flavor are due; caffeic acid, which is similar to the tannic acid in tea, but does not, like it, precipitate proteins or alkaloids and is not astringent; colloid extractive matter.

Origin and Nature of Tea.—Tea is prepared from the leaves of the tree plant, a shrub which grows more especially in India, Ceylon, China, and Japan. The better teas are prepared from the small leaves and the cheaper grades from the larger leaves.

The difference between black and green teas is due to different methods of preparation, one

important difference being that black teas are fermented before drying, for which reason they contain less tannin and volatile oil than green teas and have a different flavor. The flavor of tea is also influenced by the climate and conditions under which the plants are grown and by different blending or mixing of various teas. The majority of Indian teas are stronger than those from China and Japan.

Some of the best-grade black teas are: flowery Pekoe, orange Pekoe, Congou, the higher grade English breakfast teas, and Dajeeling, an Indian tea.

The young Hyson is one of the best green teas.

Constituents of Tea.—These are caffein; theophylline, a volatile oil, to which the flavor and odor are due; tannic acid, which is astringent and precipitates proteins and alkaloids.

Action of Coffee and Tea.—Due to the caffein which they contain, coffee and tea stimulate the nervous system, including the higher nerve centers —*i. e.*, those controlling reason, judgment, will, self-control, and the highest functions of the mind. If not taken in excess, they increase the power of mental concentration, but over-stimulation decreases this. Caffein counteracts the depressing effect of alcohol upon the nervous system and it also acts as a circulatory stimulant. Due to its volatile oil, which is slightly irritating, and heat, hot coffee may be slightly stimulating to the stom-

ach; because of this and because the action of caffein on the cerebrum will counteract that of alcohol, the after-dinner demi-tasse of black coffee may have its value, especially when wine has been drunk. The extractive matter of coffee has a laxative effect in the intestine, stimulating peristalsis, and it sometimes increases digestive disturbances when such exist. It has been found that coffee increases the acidity of the gastric juice and thus should not be used by individuals suffering with digestive disturbances associated with hyperacidity. The tannin of tea tends, by its astringent action, to retard the secretion of the gastric juice, to delay digestion and absorption, and to promote constipation; also, tannin precipitates the proteins of food, but the precipitate is soon redissolved by the gastric juice. If tea is properly made it will not contain enough tannin to be injurious to normal adults. As tea has but little extractive matter, it, when properly made, is less disturbing to the stomach than coffee, and by virtue of its heat and volatile oil hot tea is sometimes of use in overcoming nausea, as in seasickness.

Tea and coffee should be used in very limited quantities, if at all, by those suffering with digestive disturbances, nervousness, and insomnia, and they should not be given children until all symptoms of puberty are passed, since stimulation of the nervous system, such as is produced by caffein, may be then very injurious.

Food-value.—Coffee and tea have no food value in themselves, but as sugar and cream or milk are generally used with them they serve as a means of adding a small amount of nutritive material to the diet.

Adulteration.—Coffee is often adulterated with chicory, acorns, beans, roasted cereals, and pulverized date stones. These can generally be detected by examining the coffee under a strong magnifying glass. Under the glass the coffee particles appear quite different from the adulterants; chicory, especially, having a gummy appearance, stands out in strong contrast to the coffee. Another test often used is the iodin test: as the adulterants commonly used, with the exception of chicory, contain starch or dextrin, if they are present, a blue or purple color will show when iodin is added to an infusion of the coffee. Still another test is to put a small amount of coffee into a bottle half full of water, shake the bottle vigorously, and then let it stand quietly. Pure coffee contains a large amount of oil and, consequently, it will float, for quite a time, while the adulterant substitutes will sink to the bottom of the flask.

The common method of adulterating tea is to mix broken large leaves or leaves of other plants with the small tea leaves. Such adulteration can be detected by moistening the leaves, unrolling them, and examining them under a strong magnifying glass.

Caffein-Free Coffees

There are some coffees—*e. g.*, *kaffee hag*—from which, by heating the berries under special conditions, much of the caffein has been removed. Some of these contain as little as 0.3 per cent., but it is thought doubtful if any of them are actually free from it, as the name implies.

Coffee Substitutes

There are various preparations on the market that consist of such substances as parched corn, baked wheat, dried peas, bread crust, and the like which are called coffee substitutes. Many of them, however, contain a considerable amount of coffee.

Tea Substitutes

Infusions of leaves of various plants containing volatile oils are sometimes used as beverages and are called *teas; e. g.*, anise tea, mountain tea, peppermint tea, sage tea, sassafras tea.

Theobromin Beverages

The principal theobromin beverages are chocolate and cocoa.

Origin and Composition of Chocolate.—Chocolate is made from the ripe seeds of the bean of the

Theobroma cacao, a plant which is now grown in many tropical countries. The seeds are fermented, dried, roasted, and deprived of their shells, which are known as *cocoa nibs.*

Chocolate contains from 0.3 to 2.0 per cent. theobromin, 10 per cent. starch, 15 per cent. protein, and 30 to 50 per cent. fat, which is known as *cacao* or *cacao butter.* The chocolate flavor is developed in the roasting; this flavor is not pleasant, but it becomes so upon the addition of sugar and flavoring matter, as vanilla, to the chocolate.

Derivation and Nature of Cocoa.—Cocoa is a powder prepared from chocolate by the removal of a portion of its fat by hydraulic pressure. Thus, cocoa contains a smaller per cent. of fat than chocolate (it has about 15 to 30 per cent.), and a larger per cent. of theobromin. Considerable extra starch is usually mixed with the cocoas sold cheaply and thus these have smaller per cents. of both theobromin and fat.

As shown by their composition, chocolate and cocoa have, unlike tea and coffee, a food value of their own and the theobromin stimulates both cardiac and skeletal muscles so that these beverages have a slight stimulating action, but they do not have the same stimulating effect upon the nervous system that tea and coffee have. Unfortunately, the fat which they contain sometimes retards the secretion of the gastric juice and thus may interfere with digestion.

Alcoholic Beverages

The alcoholic beverages in common use are made by fermenting sugar solutions, usually with yeast in the presence of nitrogenous substances. The sugar may be that of a fruit juice, or that produced by the action of the yeast, or ferments from other sources, on starch or cellulose.

Classification.—Alcoholic beverages are generally classified as: wines, distilled liquors or spirits, elixirs, malt liquors.

Wines.—These are spoken of as **red**, white, dry, sweet, light, sparkling, fortified.

Red wines are prepared by fermenting the juice of grapes in the presence of their skins. They contain tannic acid and are therefore more astringent than **white wines**, which are made from the juice of grapes the skins and seeds of which have been removed.

A **sweet wine** is one which contains free sugar, and a **dry wine** one that does not.

A **sparkling wine** is one that contains CO_2—*e. g.*, champagne.

A **light wine** is one that has a low per cent. of alcohol, and a **strong wine** one that has a comparatively large amount, but not above 17 per cent., while a **fortified wine** is one that contains a higher per cent. than 17. The action of yeast is inhibited when there is more than 15 to 17 per cent. alcohol in the fermenting material, and therefore, to obtain a beverage containing more than 17 per

cent. alcohol, either the alcohol is distilled from the fermenting material or else, as is done in the making of fortified wines, alcohol is added. Light wines, such as claret and sauterne, contain about 7 to 12 per cent. alcohol. Fortified wines, such as Madeira, sherry, and port, contain about 17 to 25 per cent.

Apple and pear cider and similar beverages are often classed as wines, since they are prepared by the fermentation of the fruit sugar in the juice of the apples, pears, etc. They generally contain about 0.50 to 1 per cent. alcohol. Ciders that are not sweet are likely to contain more alcohol than those which are, because the lack of sweetness is likely to be due to a greater degree of fermentation of the fruit sugar.

Distilled Liquors or Spirits.—These are made by distilling different kinds of fermented liquors. Examples are whiskey, gin, brandy, and rum.

Whiskey is prepared by distilling the mash of fermented grain, such as corn, rye, wheat, barley. To be good, whiskey must be not less than four years old. It contains 44 to 55 per cent. by volume, of ethyl alcohol.

Gin is made by redistilling the distillate obtained in making whiskey with juniper berries. It contains from 60 to 70 per cent. alcohol and a volatile oil obtained from the juniper berries.

Brandy is obtained by the distillation of the fermented juice of grapes. It contains about 45 to 55 per cent. alcohol.

Rum is a distillate of fermented molasses. It varies in strength, but generally contains about 45 to 55 per cent. of alcohol.

Elixirs.—These are aromatic alcoholic mixtures containing varying but large amounts of alcohol, as well as different flavoring substances and sugar. The various liqueurs and cordials are of this class; examples are: absinthe, Chartreuse, crême de menthe, Curaçao, maraschino.

Malt Liquors.—These are made from starchy substances, usually grain. The grain is ground and boiled with water; barley malt is added after the *mash* has been reduced to the desired temperature, and, as the barley contains the ferment diastase, it changes the starch to dextrin and some of the dextrin to maltose and glucose. Hops also are added, and they yield a bitter principle and a substance with slight hypnotic properties to the liquid. When this part of the process is completed, the liquid is removed by filtration and yeast added to the filtrate. After the fermentation caused by the yeast has been carried to the desired degree, the yeast is killed by heat. As the fermentation is stopped before all the sugars are destroyed, the malt liquors contain varying amounts of free sugar. Also, they contain the various products of the fermentation of sugars, viz., alcohol (3–7 per cent.), acids, carbon dioxid, and the bitter principle derived from the hops.

The chief malt liquors are ale, beer, porter, and stout. The ordinary varieties of ale and beer

are very similar, the slight differences that exist being due chiefly to the different yeasts that are used; beer being fermented by *bottom yeast* (yeast that sinks) and ale by *top yeast* (that which floats). True *lager beer*—so-called from the German *lager = a storehouse*—is beer that is stored for several months before use. Porter and stout are ales of which the malt, before fermentation, was roasted until it changed to caramel. Stout is the richer and stronger of the two.

There are also a number of beverages, some of which are called beer or ale, consisting of sugar solutions flavored with essences consisting of extracts from certain plants, or their imitation products, and fermented with yeasts; *e. g.*, ginger beer, sarsaparilla. These contain small amounts of alcohol, but rarely more than 1 per cent.

Dietetic Value of Alcohol.—Alcoholic beverages, by stimulating the taste-buds and olfactory nerves, act as appetizers and induce a psychic secretion of digestive juices. Beverages containing less than 20 per cent. alcohol do not seem to affect the digestive ferments and they hasten the absorption of other substances, such as the digestive products of food, drugs, etc., but strong solutions will retard the action of digestive ferments, and precipitate the proteins of food so that they retard digestion; also, they tend to produce a thick mucus on the mucous membrane, especially of the stomach, and thus they interfere with absorption.

Alcohol is easily oxidized in the body and every

gram oxidized will yield seven calories. Being more readily oxidized than more complex substances, alcohol spares food products and body tissue from oxidation, but it is not used in the body for tissue building.

The waters and fruit juices have been considered elsewhere.

CHAPTER XII

FOOD REQUIREMENT AND MENUS

Amounts of Food Required per Day under Differing Conditions—Causes for Differences in Food Requirements—Points to Consider in Planning Menus—Method of Calculating the Amounts of Food Principles and the Caloric Value of Foods—Tables Showing the Composition of Common Foods.

Food Requirement

How Studied.—Decisions as to the amount of food required by the body have been chiefly based upon experiments carried out with the aid of an apparatus known as the *respiratory calorimeter.* Figs. 68–71 show the nature of this and a description of the apparatus and of the experiments performed will be found in the U. S. Department of Agriculture, Bulletin 175, "Experiments on the Metabolism of Matter and Energy in the Human Body." In performing experiments with this apparatus, all the food and beverages used by the subject and the amount of air entering the chamber in which the subject remains during an experiment

are measured or weighed, as are also all excreta, including the CO_2 and heat eliminated by the subject.

As the result of experiments, it has been found that a man of average weight, *i. e.*, about 156 pounds (70 kilograms), under the conditions here specified, eliminates the following amounts of heat, estimated in calories:

	Calories per hour
During sleep	65
During rest, but awake	100
During light muscular exercise	170
During active muscular exercise	200
During hard muscular exercise	450
During very hard muscular exercise	600

The amount of heat eliminated gives a clue to the quantity of food that is required, because the heat eliminated was produced by the oxidation of food material and if, under existing circumstances, definite amounts of food are oxidized, this is the quantity of food that must be supplied for such conditions.

Factors Influencing Food Requirement.—As can be appreciated from the foregoing table, muscular contraction is the most important factor in regulating the rate of oxidation in the body. The other two particularly important influences are the extent of body surface from which heat can be lost and individual idiosyncrasies.

Naturally, the two factors first mentioned depend largely upon the nature of the individual's occupation and sex, size and age.

Influence of Occupation.—The muscles of a person who spends the greater part of the day writing or teaching will not be undergoing as great an amount of contraction as will those of a man who, for example, is sawing wood or lifting heavy weights, and, therefore, the quantity of material that will undergo oxidation in his body tissues will be less and he will thus need a smaller supply of fuel and repair material, *i. e.*, food. Intense concentration or excitement will produce muscular contraction and so promote oxidation, but, apart from such action, mental work does not, as far as it has been possible to ascertain, increase oxidation.

Size.—A person's size causes considerable difference in the degree of oxidation that occurs in the body. For one reason, there is a greater amount of muscle to contract and muscular contraction includes, not only that occurring in external work, but (1) the contraction known as *muscle tone*, that is constantly present in all normal living muscle, and (2) the contraction of the visceral muscles.[1] Size is also of importance in that the larger the body, the greater is the extent of surface by which heat can be lost. A tall thin person will, for both this and the influences previously

[1] The energy expended for these purposes is spoken of as the *maintenance requirement of energy*, for it is necessary to maintain life. It includes that used for the maintenance of: muscle tone, respiration, circulation, digestion, assimilation, the work of secretory glands, and intracellular activities. It is for these purposes that energy is required while a person sleeps.

mentioned, use more fuel than a short fat person of similar weight.

Sex.—Women use less food than men, because they, as a rule, weigh less, expend less energy in their movements, and, it is thought, their cells do not oxidize matter as readily as those of men.

Age.—Children need less food as a whole than adults, but they need more in proportion to their weight, since they need material, not only for fuel and repair, but also for growth, and in youth oxidation and assimilation processes go on more rapidly than in later years. After middle life is passed, as bodily vigor diminishes, oxidation processes go on more and more slowly and there is a tendency to store fat in the tissues. For this reason, as age advances, the diet should be gradually restricted to about eight or nine tenths of the average adult ration.

Climate and Atmospheric Temperature.—These have less influence upon the amount, than upon the kind, of food that is required; though, as the tendency is to move more slowly when it is hot than when it is cold, rather less food is usually needed in hot climates and weather, than in cold, and, when it is cold, unless sufficient clothing is worn to prevent the body becoming chilled, the cold will increase the natural degree of muscular contraction and, consequently, of oxidation.

Health.—In convalescence from illness that has been associated with loss of flesh and during fever, when oxidation goes on at an abnormally

rapid rate, extra food is required unless there are conditions present which render its use undesirable. These points will be further considered in the section on Diet in Disease.

Idiosyncrasy.—In some individuals, metabolism goes on more slowly than in the majority of people and they will maintain their weight and health upon considerably less food than the usual average. On the other hand, there are individuals in whom metabolism occurs unusually rapidly and, though they eat as much, or even more food than most persons of their sex, size, and occupation, they remain exceptionally thin.

One cause of such differences is thought to lie in the nervous system, since many of the important processes influencing metabolism (*e. g.*, muscular contraction, the circulation, heat elimination) are under the control of this system. Another cause is thought to lie in the relative degree of cell activity. This, it is thought, is greater in some persons and less in others than in the majority of people and, under such circumstances, catabolism and loss of heat take place more quickly, or in the second instance more slowly, than is usual. The reasons for such differences in cell activity are but imperfectly understood. In some individuals, they are apparently normal conditions, for the individuals are perfectly healthy, in others, they are often the result of abnormal causes; *e. g.*, in the disease known as *myxedema*, depression of metabolic processes is, primarily, the result of

lack of thyroid secretion and in Graves's disease —*exophthalmic goitre*—catabolism goes on at an abnormally rapid rate under the influence of an excess of thyroid secretion. The characteristic changes in metabolism common in old age are partly due to diminished internal secretions and changes in the circulation.

Body Weight.—Ordinarily, the body weight may be taken as a guide to ascertain if sufficient food is being taken, for, if healthy persons maintain their normal weight, they must of necessity be getting sufficient food.

The following tables show the relation of weight to height which life insurance companies consider the most favorable at different ages:

TABLE OF HEIGHT AND WEIGHT AT DIFFERENT AGES

BASED UPON AN ANALYSIS OF 74,162 ACCEPTED MALE APPLICANTS FOR LIFE INSURANCE, AS REPORTED TO THE ASSOCIATION OF LIFE INSURANCE MEDICAL DIRECTORS, 1897

Height	*Weight*									
AGES	15–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64	65–69
5 ft. 0 in.	120	125	128	131	133	134	134	131	131	
1 "	122	126	129	131	134	136	136	136	134	
2 "	124	126	131	133	136	138	138	137	137	
3 "	127	131	134	136	139	141	141	141	140	140
4 "	131	135	138	140	143	144	145	145	144	143
5 "	134	138	141	143	146	147	149	149	148	147
6 "	138	142	145	147	150	151	153	153	153	151
7 "	142	147	150	152	155	156	158	158	158	156
8 "	146	151	154	157	160	161	163	163	163	162
9 "	150	155	159	162	165	166	167	168	168	168
10 "	154	159	164	167	170	171	172	173	174	174
11 "	159	164	169	173	175	177	177	178	180	180
6 " 0 "	165	170	175	179	180	183	182	183	185	185
1 "	170	177	181	185	186	189	188	189	189	189
2 "	176	184	188	192	194	196	194	194	192	192
3 "	181	190	195	200	203	204	201	198		

SYMONDS'S TABLE OF WEIGHTS FOR WOMEN

BASED ON 58,855 ACCEPTED APPLICANTS FOR LIFE INSURANCE

Height	*Weight*									
AGES	15–19	20–24	25–29	30–34	35–39	40–44	45–49	50–54	55–59	60–64
4 ft. 11 in.	111	113	115	117	119	122	125	128	128	126
5 " 0 "	113	114	117	119	122	125	128	130	130	129
1 "	115	116	118	121	124	128	131	133	134	132
2 "	117	118	120	123	127	132	134	137	137	136
3 "	120	122	124	127	131	135	138	141	141	140
4 "	123	125	127	130	134	136	142	145	145	144
5 "	125	128	131	135	139	143	147	149	149	q48
6 "	128	132	135	137	143	146	151	153	153	152
7 "	132	135	139	143	147	150	154	157	156	155
8 "	136	140	143	147	151	155	158	161	161	160
9 "	140	144	147	151	155	159	163	166	166	165
10 "	144	147	151	155	159	163	167	170	170	169

Though weight furnishes a guide by which to judge of the correctness of the amount of food being used, it does not necessarily always show that the food is of the best kind; for example, children, and even adults, getting a diet containing an excess of carbohydrate food and sadly lacking in protein, mineral matter, and vitamines, may gain in weight, because they are getting fat-producing food, but, being deprived of the other essential food elements, they will soon cease to be in a healthy condition. Neither is a gain in weight an infallible indication of health, especially when it is greater than normal, in fact, in the latter case, it may show a decidedly abnormal condition, viz., a lack of some principle which is interfering with metabolism.

Bad Effects of Overfeeding and Underfeeding.

—The following are some of the more common bad results likely to follow constant excessive overfeeding: (1) gastric distention; (2) various forms of digestive disturbances due to throwing an undue amount of work on the digestive organs; (3) general malaise, resulting from auto-intoxication, following the absorption of excessive amounts of products of intestinal putrefaction; (4) obesity.

The chief effects of insufficiency of food are, a general impairment of the health which unfits the body to resist disease and, in children, defective development, both physical and mental. Ill results will follow not only insufficiency of food as a whole, but lack of any essential food element. Those most likely to be deficient are proteins, iron, phosphates, and calcium. The effects of lack of these principles have been already discussed.

Quantity of Food Required per Day.—To form an accurate estimate of the amount of food required, it would be necessary to take into account the number of hours spent in sleep, in light labor, hard labor, etc., but, except in research work, such accuracy is not necessary and estimates have been made based upon the average amount of energy expended during the day by those engaged in different occupations. The following table gives such estimates expressed in calories for a man of average weight:

	Required calories per day about
A man at rest, as a patient in bed[1]	2000
A man engaged in a sedentary occupation, *e. g.*, clerical work	2500
Man whose occupation entails moderate muscular labor, as a house painter.	3000
Man whose occupation necessitates hard muscular labor, *e. g.*, a farm laborer	3500
Man engaged in strenuous occupation, *e. g.*, a lumberman.	5000

A woman requires about four fifths as much food as a man.

The average amounts required by children at different ages are as follows:

A child	of	14 to	16	years	requires	0.8	the	food	of	a man	doing	moderate	work.
"	"	10 "	13	"	"	0.6	"	"	"	"	"	"	"
"	"	6 "	9	"	"	0.5	"	"	"	"	"	"	"
"	"	3 "	5	"	"	0.4	"	"	"	"	"	"	"
"	"	2		"	"	0.3	"	"	"	"	"	"	"

An infant, during its first year of life, needs about 100 calories per kilogram, per day, and during its second year about 70 calories per kilogram.

Relative Proportions of Food Principles Required in the Diet.—This is still a matter of debate and experiment. As regards protein, Hutchinson, Chittendon, and other writers of note point to the fact that in milk, which adequately supplies the total protein requirement at the period of life when there is the most rapid growth, only one ninth per cent. of the food supply is pro-

[1] It is often advisable to give sick persons more food than necessary for actual requirement at the time, especially during convalescence from long illness and during fever.

tein. Professor Langworthy, a noted American investigator of nutritional problems, gives 12 per cent. as an advisable average protein allowance. This would mean that of sufficient food to yield 3000 calories enough to give 360 calories should be protein, which would mean 90 grams, since each gram of protein will yield 4 calories. The remaining 2640 calories are obtained from fats and carbohydrates. The ratio in which these are used varies, depending largely upon: (1) climate, more fat being used in cold than in warm climates. (2) The individual; in some persons, digestive disturbances are easily caused by fat, while the same is true of carbohydrates in others, especially if there is a tendency to gastric hyperacidity. (3) The nature of the meal; when much of the food used contains a large percentage of solids in proportion to its bulk, the fat content of the meal should be low. Usually, except in abnormal conditions, a diet that is sufficient in quantity and well proportioned otherwise, will contain enough mineral matter. The conditions calling for attention to the mineral content of meals were considered in Chapter III.

Other Points beside the Amount of Food to be Considered in Making out Menus.—Some of the more important points to be considered in making out menus other than the amount of food are: The cost; the time required for the preparation of the food as compared with the number of people that there are to prepare it (some foods, *e. g.*, fresh peas, take a long time to get ready for

use); the season of the year (many foods which are particularly appetizing in winter are the reverse on a hot summer day); the likes and dislikes of the people who are to partake of the meal, *e. g.*, the food that would appeal to a delicate society woman would not be likely to please a laboring man with a healthy appetite; the selection of a good combination of flavors; not to choose too many dishes calling for sauces and gravies; the selection of foods that when combined will not give too large a proportion of any of the food principles, *e. g.*, pea soup, pork, and pie served at the same meal would furnish too large a proportion of fat, and a meal containing fish, beef, Lima beans, cheese, and custard would yield too much protein.

Divisioning of Day's Food Requirement.—As a rule, about one third of the day's requirement is used for lunch, somewhat less than this for breakfast, and proportionately more for dinner. For example, if the day's allowance is 75 grams of protein, 75 grams of fat, 258 grams of carbohydrates, it can be proportioned about as follows:

	Protein	*Fat*	*Carbohydrates*	*Calories*
Breakfast	20 grs.	20 grs.	70 grs.	540
Lunch	25 "	25 "	83 "	657
Dinner	30 "	30 "	105 "	810

Method of Planning Menus.—First, choose the food, having in mind the points mentioned in the preceding paragraphs; then reckon the amounts needed for the number of individuals to be provided for. This is best ascertained by measuring

or weighing amounts that seem suitable, but, if this is not practicable, a table giving the average amounts of some typical foods required per capita will be found on page 215. It must be remembered, however, that the amounts needed vary considerably in accordance with the number and kind of foods served for a meal and that quantities can be cut down somewhat when a large number of people are to be provided for.

Having decided upon the amounts of food required with the help of one or other of the tables on pages 203 to 219, reckon the quantity of each of the organic food principles in each of the foods chosen, and if the latter do not yield a fairly accurate total of the three principles, make necessary changes in either the quantities or kinds of food.

It will be found that no two tables obtained from different sources tally exactly, because, as can be easily appreciated, each kind of food, though very similar in its composition, is likely to vary slightly so that different chemists have obtained somewhat different results on analysis. As a matter of fact, the food used may not be identical in its quantitative composition with the table used, but this is not of importance, as dietaries are computed merely as a means of avoiding excess in either direction and not with any idea that it is necessary to restrict the body to its actual food requirement. Neither is it generally necessary to have the number of calories absolutely correct, and, as a rule, in recording the

calories fractions are disregarded. Also, to facilitate reckoning, thirty grams are considered the equivalent of an ounce, though this is not quite accurate.

In computing the caloric value of food, some people still make use of the figures 4.1 for each gram of protein, 4.1 for each gram of carbohydrate, 9.3 for each gram of fat; others use the figures 4.1, 4.1, 8.9; and others count 4 for each gram of protein, 4 for each gram of carbohydrate, and 9 for each gram of fat. The reason for these differences was given in Chapter V. The last set of figures are those used in the example of the meal given here, and in Tables I. and II.

Example of Method of Computing Menu

LUNCH MENU FOR A WOMAN AT LIGHT LABOR

ALLOWANCE

Protein	*Fat*	*Carbohydrates*	*Calories*
25 grams	25 grams	83 grams	637

FOOD	Quantity	Protein	Fat	C. H.	Calories
		grams	grams	grams	
Consommé }	5 oz	3.9		.5	17
Steak }	3 oz.	14.1	13.5		178
1 Cooked tomato }	$\frac{1}{3}$ lb.	1.	5.	4.3	26
Mashed potatoes	$2\frac{1}{3}$ oz.	2.7	4.9	17.8	125
Strawberries	5 "	1.3	.9	10.5	54
Cream	1 "	.8	3.7	1.	40
Sugar	3 dr.			10.5	42
Graham Muffins		3.2	2.7	21.9	125
Tea	2 "				
Cream	$\frac{1}{2}$ oz.	.4		.5	20
Sugar	1 dr.		1.9	3.5	14
Total		27.4	28.1	70.5	641

To discover the food value of dishes containing a number of ingredients it is necessary to compute the individual items as follows:

MASHED POTATOES

FOOD	Quantity	Proteid	Fat	C. H.	Calories
		grams	grams	grams	
Potatoes	$2\frac{1}{2}$ oz.	2.1	.3	17.	79
Milk	3 dr.	.5	1.	.8	14
Butter	1 "	.1	3.6		33
Total		2.7	4.9	17.8	126

TABLE I[1]

The first section of this table gives the percentage composition; the second, the amount of organic food principles in 1 ounce (30 grams) and the caloric value of the specified foods.

FOODS	Percentage Composition					Amount of Organic Food Constituents in 1 ounce (30 grams)			Fuel Value
	% Water	*% Protein*	*% Fat*	*% Carbohydrates*	*% Ash*	*Protein grams*	*Fat grams*	*Carbohydrates grams*	*Calories*
ANIMAL FOODS MEATS									
Beef, cooked:									
Roast	48.2	22.3	28.6	.....	1.3	6.69	8.58	.....	104
Pressed	44.1	23.6	27.7	.....	1.5	7.08	8.31	.....	103
Round steak	63.0	27.6	7.7	.....	1.8	8.28	2.31	.....	54
Sirloin steak	63.7	23.9	10.2	.....	1.4	7.17	3.06	.....	56
Tenderloin steak	54.8	23.5	20.4	.....	1.2	7.05	6.12	.....	83
Beef, canned:									
Boiled beef	51.8	25.5	22.5	.....	1.3	7.65	6.75	.....	91
Chili con carne	75.4	13.3	4.6	4.0	2.7	3.99	1.38	1.20	33
Corned beef	51.8	26.3	18.7	.....	4.0	7.89	5.61	.....	82
Dried beef	44.8	39.2	5.4	.....	11.2	11.76	1.62	.....	62
Kidneys, stewed	71.9	18.4	5.1	2.1	2.5	5.52	1.53	.63	38
Roast beef	58.9	25.9	14.8	.....	1.3	7.77	4.44	.....	71
Rump steak	56.3	24.3	18.7	.....	1.5	7.29	5.61	.....	79
Sweetbreads	69.0	20.2	9.5	.....	2.0	6.06	2.85	.....	50
Tongue, whole	51.3	19.5	23.2	.....	4.0	5.85	6.96	.....	86

[1] Computed chiefly from the United States Dept. of Agriculture Bulletins No. 28 and No. 142.

Unless otherwise specified, the figures given are for the edible portion of the foods.

Foods	Percentage Composition					Amount of Organic Food Constituents in 1 ounce (30 grams)			Fuel Value
	Water %	Protein %	Fat %	Carbohydrates %	Ash %	Protein grams	Fat grams	Carbohydrates grams	Calories
Beef, corned:									
Brisket	50.9	18.3	24.7	.....	5.7	5.49	7.41	.....	89
Plate	40.1	13.7	41.9	.....	4.7	5.11	12.57	.....	134
Beef, pickled, etc.:									
Tongue, pickled	62.3	12.8	20.5	.....	4.7	3.84	6.15	.....	70
Tripe	86.5	11.7	1.2	.2	.8	3.51	.36	.....	17
Beef, salted, smoked, and dried	54.3	30.0	6.5	.....	9.1	9.00	1.95	.....	53
Uncooked beef:									
Brisket, medium fat	54.6	15.8	28.5	.....	.9	4.74	5.55	.....	69
Chuck rib, medium fat	62.7	18.5	18.0	.....	1.0	5.55	5.40	.....	70
Loin, medium fat	60.6	18.5	20.2	.....	1.0	5.55	6.06	.....	77
Loin, porterhouse steak	60.0	21.9	20.4	.....	1.0	6.57	6.12	.....	81
Loin, sirloin steak	61.9	18.9	18.5	.....	1.0	5.67	5.55	.....	73
Round, medium fat	65.5	20.3	13.6	.....	1.1	6.09	4.08	.....	61
Rump, medium fat	56.7	17.4	25.5	.....	.9	4.22	7.65	.....	63
Beef Organs:									
Kidney	76.7	16.6	4.8	.4	1.2	4.98	1.44	.12	33
Liver	71.2	20.4	4.5	1.7	1.6	6.12	1.35	.51	38
Marrow	3.3	2.2	92.8	.....	1.3	.66	27.84	.....	253
Sweetbread	70.9	16.8	12.1	.....	1.6	5.04	3.63	.....	53
Suet	13.7	4.7	81.8	.....	.3	1.41	24.54	.....	225
Tongue	70.8	18.9	9.2	.....	1.0	5.67	2.76	.....	48
Veal, cooked:									
Cutlet	68.95	28.9	1.4	.....	.6	8.67	.42	.....	38
Roast	70.92	27.6	1.2	.....	.7	8.28	.36	.....	36
Calf's foot jelly	77.60	4.3	.....	17.4	.5	1.29	.....	5.22	26
Veal, uncooked:									
Breast, medium fat	56.4	19.4	13.8	.....	1.0	5.82	4.14	.....	61
Chuck, medium fat	73.3	19.7	6.5	.....	1.0	5.91	1.95	.....	41
Leg, medium fat	70.0	20.2	9.0	.....	1.2	6.06	2.70	.....	49
Leg, cutlet	70.7	20.3	7.7	.....	1.1	6.09	2.31	.....	45
Lamb, cooked:									
Chops, broiled	4.76	21.7	29.9	.....	1.3	6.51	8.97	.....	106
Leg, roast	67.1	19.7	12.7	.....	.8	5.91	3.81	.....	58
Lamb, uncooked:									
Breast	56.2	19.1	23.6	.....	1.0	5.73	7.18	.....	87
Leg, hind, medium fat	63.9	19.2	16.5	.....	1.1	5.76	4.95	.....	68
Shoulder	51.8	18.1	29.7	.....	1.0	5.43	8.91	.....	102
Mutton, cooked:									
Leg, roast	50.9	25.0	22.6	.....	1.2	7.50	6.78	.....	91
Mutton uncooked:									
Leg, hind, medium fat	62.8	18.5	18.0	.....	1.0	5.55	5.40	.....	71
Shoulder, medium fat	61.9	17.7	19.9	.....	.9	5.31	5.97	.....	74

Foods	Percentage Composition % Water	% Protein	% Fat	% Carbohydrates	% Ash	Amount of Organic Food Constituents in 1 ounce (30 grams) Protein grams	Fat grams	Cyrbohydrates grams	Fuel Value Calories
Pork, cooked:									
Chops	60.30	25.4	13.6	.....	1.0	7.62	4.08	.....	67
Roast	60.68	28.4	10.6	.....	0.8	8.52	3.18	.....	62
Pork, smoked, salted, etc. See Bacon, Ham									
Pork, uncooked:									
Chuck ribs	51.1	17.3	31.1	.....	.9	5.19	9.33	.....	104
Leg (ham), fresh, medium fat	53.9	15.3	28.9	.....	.8	4.59	8.67	.....	96
Loin, chops, medium fat	52.0	16.6	30.1	.....	1.0	4.98	9.03	.....	101
Loin, tenderloin	66.5	18.9	13.0	.....	1.0	5.67	3.90	.....	58
Salted Pork:									
Salt pork, lean ends	19.9	8.4	67.1	.....	5.7	2.52	20.13	.....	191
Pigs' Feet:									
Pigs' feet	55.4	15.8	26.3	.....	.8	4.74	7.89	.....	90
Pigs' feet pickled	68.2	16.3	14.8	.....	.9	4.89	4.44	.....	59
Bacon:									
Bacon, lean	31.8	15.5	42.6	.....	11.0	4.65	12.78	.....	134
Bacon, medium fat	18.8	9.9	67.4	.....	4.4	2.97	20.22	.....	194
Ham, cooked:									
Ham, boiled	51.3	20.2	22.4	.....	6.1	6.06	6.72	.....	85
Ham, fried	36.6	22.2	33.2	.....	5.i	6.66	9.96	.....	116
Ham, luncheon	49.2	22.5	21.0	.....	5.8	6.75	6.30	.....	83
Sausages:									
Arles	17.2	26.8	50.6	.....	7.3	8.04	15.18	.....	169
Banquet	62.7	18.3	15.7	.....	3.7	5.49	4.71	.....	64
Bologna	60.0	18.7	17.6	...3	3.7	5.61	5.28	.9	70
Farmer	23.2	29.0	42.0	.....	7.0	8.70	12.60	.....	148
Frankfort (as pur. refuse 8%)	57.2	19.6	18.6	1.1	3.4	5.88	5.58	.33	75
Holsteiner	25.6	29.4	37.3	3.4	4.3	8.82	11.19	1.02	140
Lyons, pure ham	32.5	32.3	27.2	.....	8.0	9.69	8.16	.....	112
Pork (as pur. refuse 11 %)	39.8	13.0	44.2	1.1	2.2	3.90	13.26	.33	136
Pork sausage meat (as pur. refuse 1%)	46.2	17.4	32.5	.....	3.4	5.22	9.75	.....	109
Pork and beef chopped (as pur. refuse 1%)	55.4	19.4	24.1	.....	1.0	5.82	7.23	.....	88
Salmj	30.5	24.1	39.9	.....	7.0	7.23	11.97	.....	137
Summer	23.2	26.0	44.5	.....	7.7	7.80	13.35	.....	151
POULTRY									
Poultry, cooked:									
Capon	59.9	27.0	11.5	.....	1.3	8.10	3.45	.....	63
Chicken, fricassee	67.5	17.6	11.5	2.4	1.0	5.28	3.45	.72	55
Turkey, roast	52.0	27.8	18.4	.....	1.2	8.34	5.52	.....	83

Foods	Percentage Composition					Amount of Organic Food Constituents in 1 ounce (30 grams)			Fuel Value
	% Water	% Protein	% Fat	% Carbohydrates	% Ash	Protein Grams	Fat Grams	Carbohydrates grams	Calories
Poultry and Game, canned:									
Chicken	46.9	20.8	30.0	....	2.6	6.24	9.00	....	106
Turkey	47.4	20.7	29.2	....	2.7	6.21	8.76	....	103
Plover, roast	57.7	22.4	10.2	7.6	2.1	6.72	3.06	2.28	64
Quail	66.9	21.8	8.0	1.7	1.6	6.54	2.40	.51	50
Poultry, uncooked:									
Chicken, broiler	74.8	21.5	2.5	....	1.1	6.45	.75	....	23
Fowl	63.7	19.3	16.3	....	1.0	5.79	4.89	....	67
Goose	46.7	16.3	36.2	....	.8	4.89	10.86	....	117
Young turkey	55.5	21.1	22.9	....	1.0	6.33	6.87	....	87
Chicken gizzard	72.5	24.7	1.4	....	1.4	7.41	.42	....	33
Chicken heart	72.0	20.7	5.5	....	1.4	6.21	1.65	....	39
Chicken liver	69.3	22.4	4.2	2.4	1.7	6.72	1.26	.72	41
Turkey gizzard	62.7	20.5	14.5	1.2	1.1	6.15	4.35	.36	65
Turkey heart	68.6	16.8	13.2	....	1.0	5.04	3.96	....	56
Turkey liver	69.6	22.9	5.2	.6	1.7	6.87	1.56	.18	42
FISH									
Fish, cooked:									
Bluefish	68.2	25.9	4.5	....	1.2	7.77	1.35	....	43
Mackerel, Spanish	68.9	23.7	6.5	....	1.4	7.11	1.95	....	46
Fish, preserved and canned									
Cod, salt, boneless	55.0	27.3		.3	19.0	8.19	.09	....	33
Haddock, smoked	72.5	23.3	.2	....	3.6	6.99	.06	....	28
Haddock, smoked, cooked, canned	68.7	22.3	2.3	....	7.2	6.69	.69	....	33
Halibut, smoked	47.7	18.5	14.4	....	14.9	5.55	4.32	....	61
Herring, smoked	34.6	36.9	15.8	....	13.2	11.07	4.74	....	87
Salmon, canned	63.5	21.8	12.1	....	2.6	6.54	3.63	....	59
Sardines, canned	52.3	23.0	19.7	....	5.6	6.90	5.91	....	81
Sturgeon, caviare	38.1	30.0	19.7	7.6	4.6	9.00	5.91	2.28	98
Trout, brook	68.4	22.3	6.1	....	3.0	6.69	1.83	....	43
Tunny, canned	72.7	21.7	4.1	....	1.7	6.51	1.23	....	37
Tunny, canned in oil	51.3	23.8	20.0	0.6	4.3	7.14	6.00	.18	83
Fish, uncooked:									
Bass, black	76.7	20.6	1.7	....	1.2	6.18	.51	....	29
Bass, sea	79.3	19.8	.5	....	1.4	5.94	.15	....	25
Bass, striped	77.7	18.6	2.8	....	1.2	5.58	.84	....	30
Bluefish	78.5	19.4	1.2	....	1.3	5.82	.36	....	26
Butterfish	70.0	18.0	11.0	....	1.2	5.40	3.30	....	51
Catfish	64.1	14.4	20.6	....	.9	4.32	6.18	....	73
Cisco	74.0	18.5	6.8	....	1.1	5.55	2.04	....	40
Cod, whole	82.6	16.5	.4	....	1.2	4.95	.12	....	21
Cod, steaks	79.7	18.7	.5	....	1.2	5.61	.15	....	24
Eels	71.6	18.6	9.1	....	1.0	5.58	2.73	....	47
Flounders	84.2	14.2	.6	....	1.3	4.26	.18	....	19
Haddock	81.7	17.2	.3	....	1.2	5.16	.09	....	21
Halibut steak	75.4	18.6	5.2	....	1.0	5.58	1.56	....	36
Herring	72.5	19.5	7.1	....	1.5	5.85	2.13	....	43
Mackerel	73.4	18.7	7.1	....	1.2	5.61	2.13	....	41

Foods	Percentage Composition: Water %	Protein %	Fat %	Carbohydrates %	Ash %	Amount of Organic Food Constituents in 1 ounce (30 grams): Protein grams	Fat grams	Carbohydrates grams	Fuel Value: Calories
Fish, uncooked—Continued									
Muskellunge	76.3	20.2	2.5	.....	1.6	6.06	.75	.....	31
Perch, white	75.7	19.3	4.0	.....	1.2	5.79	1.20	.....	34
Red snapper	78.5	19.7	1.0	.....	1.3	5.91	.30	.....	26
Salmon	64.6	22.0	12.8	.....	1.4	6.60	3.84	.....	61
Shad	70.6	18.8	9.5	.....	1.3	5.64	2.85	.....	49
Shad roe	71.2	20.9	3.8	2.6	1.5	6.27	1.14	.78	38
Smelt	79.2	17.6	1.8	.....	1.7	5.28	.54	.....	26
Spanish mackerel	68.1	21.5	9.4	.....	1.5	6.45	2.82	.....	51
Trout, brook	77.8	19.2	2.1	.....	1.2	5.76	.63	.....	29
Trout, salmon or lake	70.8	17.8	10.3	.....	1.2	5.34	3.09	.....	49
Weakfish	79.0	17.8	2.4	.....	1.2	5.34	.72	.....	28
White	69.8	22.9	6.5	.....	1.6	6.87	1.95	.....	45
Shellfish, etc., canned:									
Clams, long	4.5	9.0	1.3	2.9	2.3	2.70	.39	.87	18
Clams, round	82.9	10.5	.8	3.0	2.8	3.15	.24	.90	18
Crabs	80.0	15.8	1.5	.7	2.0	4.74	.45	.21	24
Lobster	77.8	18.1	1.1	.5	2.5	5.43	.33	.15	25
Oysters	83.4	8.8	2.4	3.9	1.5	2.64	.72	1.17	22
Shrimps	70.8	25.4	1.0	.2	2.6	7.62	.30	.06	33
Shellfish, etc., fresh:									
Clams, long	85.8	8.6	1.0	2.0	2.6	2.58	.30	.60	15
Clams, round	80.8	10.6	1.1	5.2	2.3	3.18	.33	1.56	22
Crabs, hard-shelled	77.1	16.6	2.0	1.2	3.1	4.98	.60	.36	27
Lobster	79.2	16.4	1.8	.4	2.2	4.92	.54	.12	25
Muscles	84.2	8.7	1.1	4.1	1.9	2.61	.33	1.23	18
Oysters	88.3	6.0	1.3	3.3	1.1	1.80	.39	.99	15
Scallops	80.3	14.8	.1	3.4	1.4	4.44	.03	1.02	22
Terrapin	74.5	21.2	3.5	.....	1.0	6.36	1.05	.....	35
Turtle	79.8	19.8	.5	.....	1.2	5.94	.15	.....	25
Frogs' legs	83.7	15.5	.2	.....	1.0	4.65	.06	.....	19
Eggs, hen's:									
Uncooked	73.7	13.4	10.5	.....	1.0	4.02	3.15	.....	44
Boiled	73.2	13.2	12.0	.....	.8	3.96	3.60	.....	48
Boiled whites	86.2	12.3	.2	.....	.6	3.69	.06	.....	15
Boiled yolks	49.5	15.7	33.3	.....	1.1	4.71	9.99	.....	109
Dairy Products:									
Butter	11.0	1.0	85.0	.....	3.0	.30	25.50	.....	231
Buttermilk	91.0	3.0	.5	4.8	.7	.90	.15	14.4	11
Cheese:									
American, pale	31.6	28.8	35.9	.3	3.4	8.64	10.77	.09	132
American, red	28.6	29.6	38.3	.....	3.5	8.88	11.49	.....	139
Brie	60.2	15.9	21.0	1.4	1.5	5.77	6.30	.42	81
California, flat	34.0	24.3	33.4	4.5	3.8	7.29	10.02	1.35	125
Cheddar	27.4	27.7	36.8	4.1	4.0	8.31	11.04	1.23	137
Cheshire	37.1	26.9	30.7	.9	4.4	8.07	9.21	.27	116
Cottage	72.0	20.9	1.0	4.3	1.8	6.27	.30	1.29	33
Dutch	35.2	37.1	17.7	.....	10.0	11.13	5.31	.....	92

Foods	Percentage Composition					Amount of Organic Food Constituents in 1 ounce (30 grams)			Fuel Value
	% Water	% Protein	% Fat	% Carbohydrates	% Ash	Protein grams	Fat grams	Carbohydrates grams	Calories
Cheese—Continued									
Full cream	34.2	25.9	33.7	2.4	3.8	7.77	10.11	.72	125
Limburger	42.1	23.0	29.4	.4	5.1	6.90	8.82	.12	107
Neufchâtel	50.0	18.7	27.4	1.5	2.4	5.61	8.22	.45	98
Pineapple	23.0	29.9	38.9	2.6	5.6	8.97	11.67	.78	144
Roquefort	39.3	22.6	29.5	1.8	6.8	6.78	8.85	.54	108
Swiss	31.4	27.6	34.9	1.3	4.8	8.28	10.47	.39	129
Cream, average	74.0	2.5	18.5	4.5	.5	.75	5.55	1.35	58
Koumiss	89.3	2.8	2.1	5.4	.4	.84	.63	1.62	15
Milk:									
Casein or eiweissmilch	92.5	3.0	2.5	1.5	0.5	.90	.75	.45	12
Condensed milk, sweetened	26.9	8.8	8.3	54.1	1.9	2.64	2.49	16.23	98
Condensed, unsweetened, "evaporated cream"	68.2	9.6	9.3	11.2	1.7	2.88	2.79	3.36	50
Skimmed milk	90.5	3.4	.3	5.1	.7	1.02	.09	1.53	11
Whole milk	87.0	3.3	4.0	5.0	.7	.99	1.20	1.50	21
Whey	93.0	1.0	.3	5.0	.7	.3	.09	1.50	17
Miscellaneous:									
Beef juice	93.0	4.9	.6	....	1.5	1.47	.18	....	7
Gelatin	13.6	91.4	.1	....	2.1	27.42	.03	....	110
Isinglass	19.0	89.3	1.6	....	2.0	26.79	.48	....	111
Honey	18.2	.4	....	81.2	.2	.12	....	24.36	98
Lard, refined	....	....	100.0	....	....	....	30.00	....	270
Lard, unrefined	4.8	2.2	94.0	....	.1	.66	28.20	....	256
Oleomargarine	9.5	1.2	83.0	....	6.3	.36	24.90	....	225
PLANT FOODS									
Cereals:									
Barley, granulated	10.9	7.5	0.9	79.8	0.9	2.25	.27	23.94	107
Barley flour	11.9	10.5	2.2	72.8	2.6	3.15	.66	21.84	106
Barley, pearl	11.5	8.5	1.1	77.8	1.1	2.55	.33	23.34	107
Buckwheat flour	13.6	6.4	1.2	77.9	.9	1.92	.36	23.37	104
Buckwheat preparations:									
Farina	10.9	4.1	.4	84.1	.5	1.23	.12	25.23	107
Groats	10.9	4.1	.4	84.1	.5	1.23	.12	25.23	107
Corn meal	12.5	9.2	1.9	75.4	1.0	2.76	.57	22.62	107
Pop corn	4.3	10.7	5.0	78.7	1.3	3.21	1.50	23.61	120
Corn preparations:									
Ceraline	10.3	9.6	1.1	78.3	.7	2.88	.33	23.49	108
Hominy	11.8	8.3	.6	79.0	.3	2.49	.18	23.70	106
Hominy, cooked	79.3	2.2	.2	17.8	.5	.66	.06	5.34	29
Kafir corn	16.8	6.6	3.8	70.6	2.2	1.98	1.14	21.18	103

FOODS	Percentage Composition: % Water	% Protein	% Fat	% Carbohydrates	% Ash	Amount of Organic Food Constituents in 1 ounce (30 grams): Protein grams	Fat grams	Carbohydrates grams	Fuel Value: Calories
Corn preparations—*Cont.*									
Oatmeal	7.3	16.1	7.2	67.5	1.9	4.83	2.16	20.25	120
Oatmeal, boiled	84.5	2.8	.5	11.5	.7	.84	.15	3.45	18
Oatmeal gruel	91.6	1.2	.4	6.3	.5	.36	.12	1.89	10
Oatmeal water	96.0	.7	.1	2.9	.3	.21	.03	.87	5
Oats, rolled	7.7	16.7	7.3	66.2	2.1	5.01	2.19	19.86	119
Rice	12.3	8.0	.3	79.0	.4	2.40	.09	23.70	105
Rice, boiled	72.5	2.8	.1	24.4	.2	.84	.03	7.32	33
Rice, flaked	9.5	7.9	.4	81.9	.3	2.37	.12	24.57	109
Rice flour	8.5	8.6	6.1	68.0	8.8	2.58	1.83	20.40	108
Rye flour	12.9	6.8	.9	78.7	.7	2.04	.27	23.61	105
Wheat flour:									
Entire wheat	11.4	13.8	1.9	71.9	1.0	4.14	.57	21.57	107
Gluten	12.0	14.2	1.8	71.1	.9	4.26	.54	21.33	107
Graham	11.3	13.3	2.2	71.4	1.8	3.99	.66	21.42	108
Baker's grade	11.9	13.3	1.5	72.7	.6	3.99	.45	21.81	107
Spring wheat	12.3	11.7	1.1	74.5	.4	3.51	.33	22.35	106
Winter wheat	13.3	11.0	.9	74.4	.4	3.30	.27	22.32	105
Wheat Breakfast Foods:									
Cracked wheat	10.1	11.1	1.7	75.5	1.6	3.33	.51	22.65	108
Farina	10.9	11.0	1.4	76.3	.4	3.30	.42	22.89	109
Flaked wheat	8.7	13.4	1.4	74.3	2.2	4.02	.42	22.29	109
Force	9.28	9.4	1.3	77.0	2.9	2.82	.39	23.10	107
Germs	10.4	10.5	2.0	76.0	1.1	3.15	.60	22.80	109
Glutens	8.9	13.6	1.7	74.6	1.2	4.08	.51	22.38	110
Grapenuts	6.18	11.9	.6	79.2	2.0	3.57	.18	23.76	111
Shredded wheat	8.1	10.5	1.4	77.9	2.1	3.15	.42	23.37	110
Wheat Preparations:									
Macaroni	10.3	13.4	.9	74.1	1.3	4.02	.27	22.23	107
Macaroni, cooked	78.4	3.0	1.5	15.8	1.3	.90	.45	4.74	27
Noodles	10.7	11.7	1.0	75.6	1.0	3.51	.30	22.68	107
Spaghetti	10.6	12.1	.4	76.3	.6	3.63	.12	22.89	107
Vermicelli	11.0	10.9	2.0	72.0	4.1	3.27	.60	21.60	104
Breads:									
Cassava	10.5	9.1	.3	79.0	1.1	2.73	.09	23.70	107
Corn (johnnycake)	38.9	7.9	4.7	46.3	2.2	2.37	1.41	13.89	78
Rye	35.7	9.0	.6	53.2	1.5	2.70	.18	15.96	76
Rye and wheat	50.7	11.9	.6	35.9	.9	3.57	.18	10.77	59
Wheat Breads:									
Brown	43.6	5.4	1.8	47.1	2.1	1.62	.54	14.13	68
Gluten	38.2	9.3	1.4	49.8	1.3	2.79	.42	14.94	75
Graham	35.7	8.9	1.8	52.1	1.5	2.67	.54	15.63	78
White, made with high grade patent flour	32.9	8.7	1.4	56.5	.5	2.61	.42	16.95	82
White, made with low grade flour	40.7	12.6	1.1	44.3	1.3	3.78	.33	13.29	71
White, made with regular patent flour	34.1	9.0	1.3	54.9	.7	2.70	.39	16.47	80

Foods	Percentage Composition					Amount of Organic Food Constituents in 1 ounce (30 grams)			Fuel Value
	% Water	% Protein	% Fat	% Carbohydrates	% Ash	Protein grams	Fat grams	Carbohydrates grams	Calories
Breads—*Continued*									
White, homemade	35.0	9.1	1.6	53.3	1.0	2.73	.48	15.99	79
Vienna	34.2	9.4	1.2	54.1	1.1	2.82	.36	16.23	79
Whole wheat	38.4	9.7	.9	49.7	1.3	2.91	.27	14.91	74
Toasted white bread	24.0	11.5	1.6	61.2	1.7	3.45	.48	18.36	92
Zwieback	5.8	9.8	9.9	73.5	1.0	2.94	2.97	22.05	127
Buns:									
Cinnamon	23.6	9.4	7.2	59.1	.7	2.82	2.16	17.73	101
Currant	27.5	6.7	7.6	57.6	.6	2.01	2.28	17.28	98
Hot cross	36.7	7.9	4.8	49.7	.9	2.37	1.44	14.91	82
Sugar	29.6	8.1	6.9	54.2	1.2	2.43	2.07	16.26	93
Rolls:									
French	32.0	8.5	2.5	55.7	1.3	2.55	.75	16.71	84
Vienna	31.7	8.5	2.2	56.5	1.1	2.55	.66	16.95	84
Crackers:									
Butter	7.2	9.6	10.1	71.6	1.5	2.88	3.03	21.48	125
Cream	6.8	9.7	12.1	69.7	1.7	2.91	3.63	20.91	128
Graham	5.4	10.0	9.4	73.8	1.4	3.00	2.82	22.14	126
Oatmeal	6.3	11.8	11.1	69.0	1.8	3.54	3.33	20.70	127
Oyster	4.8	11.3	10.5	70.5	2.9	3.39	3.15	21.15	126
Pretzels	9.6	9.7	3.9	72.8	4.0	2.91	1.17	21.84	110
Saltines	5.6	10.6	12.7	68.5	2.6	3.18	3.81	20.55	129
Soda	5.9	9.8	9.1	73.1	2.1	2.94	2.73	21.93	124
Water	6.8	10.7	8.8	71.9	1.8	3.21	2.64	21.57	123
Cake:									
Baker's	31.4	6.3	4.6	56.9	.8	1.89	1.38	17.07	88
Chocolate layer	20.5	6.2	8.1	64.1	1.1	1.86	2.43	19.23	106
Coffee	21.3	7.1	7.5	63.2	.9	2.13	2.25	18.96	105
Cup	15.6	5.9	9.0	68.5	1.0	1.77	2.70	20.55	114
Drop	16.6	7.6	14.7	60.3	.8	2.28	4.41	18.09	121
Fruit	17.3	5.9	10.9	64.1	1.8	1.77	3.27	19.23	113
Gingerbread	18.8	5.8	9.0	63.5	2.9	1.74	2.70	19.05	107
Ladyfingers	15.0	8.8	5.0	70.6	.6	2.64	1.50	21.18	109
Macaroons	12.3	6.5	15.2	65.2	.8	1.95	4.56	19.56	127
Sponge	15.3	6.3	10.7	65.9	1.8	1.89	3.21	19.77	115
Cookies:									
Molasses	6.2	7.2	8.7	75.7	2.2	2.16	2.61	22.71	123
Sugar	8.3	7.0	10.2	73.2	1.3	2.10	3.06	21.96	124
Fig bars	17.9	4.6	6.6	69.8	1.1	1.38	1.98	20.94	107
Ginger snaps	6.3	6.5	8.6	76.0	2.6	1.95	2.58	22.80	122
Vanilla wafers	6.7	6.6	14.0	71.6	1.1	1.98	4.20	21.48	132
Doughnuts	18.3	6.7	21.0	53.1	.9	2.01	6.30	15.93	128
Jumbles	14.3	7.4	13.5	63.7	1.1	2.22	4.05	19.11	122
Pies:									
Apple	42.5	3.1	9.8	42.8	1.8	.93	2.94	12.84	82
Cream	32.0	4.4	11.4	51.2	1.0	1.32	3.42	15.36	97

Foods	Percentage Composition					Amount of Organic Food Constituents in 1 ounce (30 grams)			Fuel Value
	% Water	% Protein	% Fat	% Carbohydrates	% Ash	Protein grams	Fat grams	Carbohydrates grams	Calories
Pies—Continued									
Custard	62.4	4.2	6.3	26.1	1.0	1.26	1.89	7.83	53
Lemon	47.4	3.6	10.1	37.4	1.5	1.08	3.03	11.22	76
Mince	41.3	5.8	12.3	38.1	2.5	1.74	3.69	11.43	86
Raisin	37.0	3.0	11.3	47.2	1.5	.90	3.39	14.16	91
Squash	64.2	4.4	8.4	21.7	1.3	1.32	2.52	6.51	54
Puddings:									
Indian meal	60.7	5.5	4.8	27.5	1.5	1.65	1.44	8.25	53
Rice custard	59.4	4.0	4.6	31.4	.6	1.20	1.38	9.42	55
Tapioca	64.5	3.3	3.2	28.2	.8	.99	.96	8.46	46
Starches:									
Arrowroot	2.3	....	....	97.5	.2	....	....	29.25	117
Cornstarch	....	....	....	90.0	....	....	....	27.00	108
Sago	12.2	9.0	.4	78.1	.3	2.70	.12	23.43	106
Tapioca	11.4	0.4	.1	88.0	.1	.12	.03	26.40	106
Sugars, etc.:									
Brown	....	....	....	95.0	....	....	....	28.50	114
Granulated	....	....	....	100.0	....	....	....	30.00	120
Maple	....	....	....	82.8	....	....	....	24.84	99
Powdered	....	....	....	100.0	....	....	....	30.00	120
Molasses	25.1	2.4	....	69.3	3.2	.72	....	20.79	86
Syrup, maple	28.6	....	....	71.4	....	....	....	21.42	86
Vegetables:									
Artichokes	79.5	2.6	.2	16.7	1.0	.78	.06	5.01	24
Asparagus	94.0	1.8	.2	3.3	.7	.54	.06	.99	6
" cooked	91.6	2.1	3.3	2.2	.8	.63	.99	.66	14
Beans, butter	58.9	9.4	.6	29.1	2.0	2.82	.18	8.73	48
" dried	12.6	22.5	1.8	59.6	3.5	6.75	.54	17.88	103
" Lima, dried	10.4	18.1	1.5	65.9	4.1	5.43	.45	19.77	104
" " fresh	68.5	7.1	.7	22.0	1.7	2.13	.21	6.60	37
" soy	11.0	32.9	18.1	28.7	4.9	9.87	5.43	8.61	123
" " flour	9.3	39.5	13.7	28.2	4.0	11.85	4.11	8.46	118
" string, cooked	95.3	.8	1.1	1.9	.9	.24	.33	.57	6
" " fresh	89.2	2.3	.3	7.4	.8	.69	.09	2.22	12
Beets, cooked	88.6	2.3	.1	7.4	1.6	.69	.03	2.22	12
" fresh	87.5	1.6	.1	9.7	1.1	.48	.03	2.91	14
Cabbage	91.5	1.6	.3	5.6	1.0	.48	.09	1.68	9
" sprouts	88.2	4.7	1.1	4.3	1.7	1.41	.33	1.29	14
Carrots	88.2	1.1	.4	9.3	1.0	.33	.12	2.79	14
Cauliflower	92.3	1.8	.5	4.7	.7	.54	.15	1.41	9
Celery	94.5	1.1	.1	3.3	1.0	.33	.03	.99	6
Corn, green	75.4	3.1	1.1	19.7	.7	.93	.33	5.91	30
Cucumbers	95.4	.8	.2	3.1	.5	.24	.06	.93	5
Eggplant	92.9	1.2	.3	5.1	.5	.36	.09	1.53	8
Greens, beets	89.5	2.2	3.4	3.2	1.7	.66	1.02	.96	16
" dandelions	81.4	2.4	1.0	10.6	4.6	.72	.30	3.18	18
Kohl-rabi	91.1	2.0	.1	5.5	1.3	.60	.03	1.65	19
Leeks	91.8	1.2	.5	5.8	.7	.36	.15	1.74	9
Lentils, dried	8.4	25.7	1.0	59.2	5.7	7.71	.30	17.76	104

Foods	Percentage Composition % Water	% Protein	% Fat	% Carbohydrates	% Ash	Amount of Organic Food Constituents in 1 ounce (30 grams) Protein grams	Fat grams	Carbohydrates grams	Fuel Value Calories
Vegetables—Continued									
Lettuce	94.7	1.2	.3	2.9	.9	.36	.09	.87	5
Mushrooms	88.1	3.5	.4	6.8	1.2	1.05	.12	2.04	13
Okra	90.2	1.6	.2	7.4	.6	.48	.06	2.22	11
Onions	87.6	1.6	.3	9.9	.6	.48	.09	2.97	15
" cooked and prepared	91.2	1.2	1.8	4.9	.9	.36	.54	1.47	12
Parsnips	83.0	1.6	.5	13.5	1.4	.48	.15	4.05	19
Peas, dried	9.5	24.6	1.0	62.0	2.9	7.38	.30	18.60	107
" green	74.6	7.0	.5	16.9	1.0	2.10	.15	5.07	30
" cooked	73.8	6.7	3.4	14.6	1.5	2.01	1.02	4.38	35
" sugar	81.8	3.4	.4	13.7	.7	1.02	.12	4.11	22
Potatoes	78.3	2.2	.1	18.4	1.0	.66	.03	5.52	25
" evaporated	7.1	8.5	.4	80.9	3.1	2.55	.12	24.27	108
" boiled	75.7	2.5	.1	20.9	1.0	.75	.03	6.27	28
" chips	2.2	6.8	39.8	46.7	4.5	2.04	11.94	14.01	172
" mashed and creamed	75.1	2.6	3.0	17.8	1.5	.78	.90	5.34	33
Potatoes, sweet	69.0	1.8	.7	17.4	1.1	.54	.21	8.22	37
" " cooked and prepared	51.9	3.0	2.1	42.1	.9	.90	.63	12.63	70
Pumpkins	93.1	1.0	.1	5.2	.6	.30	.03	1.56	8
Radishes	91.8	1.3	.1	5.8	1.0	.39	.03	1.74	9
Rhubarb	94.4	.6	.7	8.6	.7	.18	.21	1.08	7
Sauerkraut	88.8	1.7	.5	3.8	5.2	.51	.15	1.14	8
Spinach	92.3	2.1	.3	3.2	2.1	.63	.09	.96	7
" cooked	89.8	2.1	4.1	2.6	1.4	.63	1.23	.78	17
Squash	88.3	1.4	.5	9.0	.8	.42	.15	2.70	14
Tomatoes	94.3	.9	.4	3.9	.5	.27	.12	1.17	7
Turnips	89.6	1.3	.2	8.1	.8	.39	.06	2.43	12
Vegetables, canned:									
Artichokes	92.5	.8	.....	5.0	1.7	.24	.....	1.50	7
Asparagus	94.4	1.5	.1	2.8	1.2	.45	.03	.84	5
Beans, baked	68.9	6.9	2.5	19.6	2.1	2.07	.75	5.88	39
" string	93.7	1.1	.1	3.8	1.3	.33	.03	1.14	6
" wax	94.6	1.0	.1	3.1	1.2	.30	.03	.93	5
" hericots	95.2	1.1	.1	2.5	1.1	.33	.03	.75	4
" Lima	79.5	4.0	.3	14.6	1.6	1.20	.09	4.38	23
Brussels sprouts	93.7	1.5	.1	3.4	1.3	.45	.03	1.02	6
Corn	76.1	2.8	1.2	19.0	.9	.84	.36	5.70	29
Peas, green	85.3	3.6	.2	9.8	1.1	1.08	.06	2.94	17
Potatoes, sweet	55.2	1.9	.4	41.4	1.1	.57	.12	12.42	53
Pumpkins	91.6	.8	.2	6.7	.7	.24	.06	2.01	10
Squash	87.6	.9	.5	10.5	.5	.27	.15	3.15	15
Succotash	75.9	3.6	1.0	18.6	.9	1.08	.30	5.58	29
Tomatoes	94.0	1.2	.2	4.0	.6	.36	.06	1.20	7
Pickles, Condiments, etc.									
Catsup	82.8	1.5	.2	12.3	3.2	.45	.06	3.69	17
Horse-radish	86.4	1.4	.2	10.5	1.5	.42	.06	3.15	15
" " dried	4.3	11.0	.8	77.7	6.2	3.30	.24	32.31	109

Foods	Percentage Composition % Water	% Protein	% Fat	% Carbohydrates	% Ash	Amount of Organic Food Constituents in 1 ounce (30 grams) Protein grams	Fat grams	Carbohydrates grams	Fuel Value Calories
Pickles—Continued									
Olives, green	58.0	1.1	27.6	11.6	1.7	.33	8.28	3.48	90
" ripe	64.7	1.7	25.9	4.3	3.4	.51	7.77	1.29	77
Peppers, green, dried (paprika)	5.0	15.5	8.5	63.0	8.0	4.65	2.55	18.90	117
Peppers, red, chili	5.3	9.4	7.7	70.0	7.6	2.82	2.31	21.00	116
Pickles, cucumber	92.9	.5	.3	2.7	3.6	.15	.09	.81	5
Fruit, Berries:									
Apples	84.6	.4	.5	14.2	.3	.12	.15	4.26	19
Apricots	85.0	1.1	.....	13.4	.5	.33	.....	4.02	17
Bananas, yellow	75.3	1.3	.6	22.0	.8	.39	.18	6.60	30
Blackberries	86.3	1.3	1.0	10.9	.5	.39	.30	3.27	17
Cherries	80.9	1.0	.8	16.7	.6	.30	.24	5.01	23
Cranberries	88.9	.4	.6	9.9	.2	.12	.18	2.97	14
Currants	85.0	1.5	.....	12.8	.7	.45	.....	3.84	17
Figs	79.1	1.5	.....	18.8	.6	.45	.....	5.64	24
Grapes	77.4	1.3	1.6	19.2	.5	.39	.48	5.76	29
Huckleberries	81.9	.6	.6	16.6	.3	.18	.18	4.98	22
Lemons	89.3	1.0	.7	8.5	.5	.30	.21	2.55	13
Muskmelon	89.5	.6	.....	9.3	.6	.18	.....	2.79	12
Nectarines	82.9	.6	.....	15.9	.6	.18	.....	4.77	20
Oranges	86.9	.8	.2	11.6	.5	.24	.06	3.48	15
Peaches	89.4	.7	.1	9.4	.4	.21	.03	2.82	12
Pears	84.4	.6	.5	14.1	.4	.18	.15	4.23	19
Persimmons	66.1	.8	.7	31.5	.9	.24	.21	9.45	41
Pineapple	89.3	.4	.3	9.7	.3	.12	.09	2.91	13
Plums	78.4	1.0	.....	20.1	.5	.30	.....	6.03	25
Pomegranates	76.8	1.5	1.6	19.5	.6	.45	.48	5.85	29
Prunes	79.6	.9	.....	18.9	.6	.27	.....	5.67	24
Raspberries, red	85.8	1.0	.....	12.6	.6	.30	.....	3.78	16
" black	84.1	1.7	1.0	12.6	.6	.51	.30	3.78	20
Raspberry juice	49.3	.5	.....	49.3	.3	.15	.....	14.79	60
Strawberries	90.4	1.0	.6	7.4	.6	.30	.18	2.22	12
Watermelons	92.4	.4	.2	6.7	.8	.12	.06	2.01	9
Whortleberries	82.4	.7	3.0	13.5	.4	.21	.90	4.05	25
Fruit, dried:									
Apples	28.1	1.6	2.2	66.1	2.0	.48	.66	19.83	87
Apricots	29.4	4.7	1.0	62.5	2.4	1.41	.30	18.75	83
Citron	19.0	.5	1.5	78.1	.9	.15	.45	23.43	98
Currants	17.2	2.4	1.7	74.2	4.5	.72	.51	22.26	96
Dates	15.4	2.1	2.8	78.4	1.3	.63	.84	23.52	104
Figs	18.8	4.3	.3	74.2	2.4	1.29	.09	22.26	95
Grapes, ground	34.8	2.8	.6	60.5	1.2	.84	.18	18.15	78
Pears	16.5	2.8	2.8	72.9	2.4	.84	.84	21.87	98
Prunes	22.3	2.1	.....	73.3	2.3	.63	.....	21.99	90
Raisins	14.6	2.6	3.3	76.1	3.4	.78	.99	22.83	103
Fruit, canned, jellied, preserved, etc.									
Apples, crab	42.4	.3	2.4	54.4	.5	.09	.72	16.32	72
Apple sauce	61.1	.2	.8	37.2	.7	.06	.24	11.16	47

Foods	Percentage Composition					Amount of Organic Food Constituents in 1 ounce (30 grams)			Fuel Value
	% Water	% Protein	% Fat	% Carbohydrates	% Ash	Protein grams	Fat grams	Carbohydrates grams	Calories
Fruit, canned—Continued									
Apricots	81.4	.9	.....	17.3	.4	.27	.....	5.19	22
Blackberries	40.0	.8	2.1	56.4	.7	.24	.63	16.92	74
Blueberries	85.6	.6	.6	12.8	.4	.18	.18	3.84	18
Cherries	77.2	1.1	.1	21.1	.5	.33	.03	6.33	27
Cherry jelly (good quality)	21.0	1.1	.....	77.2	.7	.33	.....	23.16	94
Cherry jelly (cheap grade)	38.4	1.2	.....	59.8	.6	.36	.....	17.94	73
Figs, stewed	56.5	1.2	.3	40.9	1.1	.36	.09	12.27	51
Grape butter	36.7	1.2	.1	58.5	3.5	.36	.03	17.55	72
Marmalade (orange peel)	14.5	.6	.1	84.5	.3	.18	.03	25.35	102
Peaches	88.1	.7	.1	10.8	.3	.21	.03	3.24	14
Pears	81.1	.3	.3	18.0	.3	.09	.09	5.40	23
Pineapple	61.8	.4	.7	36.4	.7	.12	.21	10.92	46
Prune sauce	76.6	.5	.1	22.3	.5	.15	.03	6.69	28
Strawberries, stewed	74.8	.7	.....	24.0	.5	.21	.....	7.20	30
Tomatoes, preserved	40.9	.7	.1	57.6	.7	.21	.03	17.28	70
Nuts:									
Almonds	4.8	21.0	54.9	17.3	2.0	6.30	16.47	5.19	194
Beechnuts	4.0	21.9	57.4	13.2	3.5	6.57	17.22	3.96	197
Brazil	5.3	17.0	66.8	7.0	3.9	5.10	20.04	2.10	209
Chestnuts, fresh	45.0	6.2	5.4	42.1	1.3	1.86	1.62	12.63	72
" dried	5.9	10.7	7.0	74.2	2.2	3.21	2.10	22.26	120
Cocoanut	14.1	5.7	50.6	27.9	1.7	1.71	15.18	8.37	177
" milk	92.7	.4	1.5	4.6	.8	.12	.45	1.38	10
" prepared	3.5	6.3	57.4	31.5	1.3	1.89	17.22	9.45	200
Filberts	3.7	15.6	65.3	13.0	2.4	4.68	19.59	3.90	210
Peanuts	9.2	25.8	38.6	24.4	2.0	7.74	11.58	7.32	164
Peanut butter	2.1	29.3	46.5	17.1	5.0	8.79	13.95	5.13	181
Pecans, polished	3.0	11.0	71.2	13.3	1.5	3.30	21.36	3.99	221
" unpolished	2.7	9.6	70.5	15.3	1.9	2.88	21.15	4.59	220
Walnuts, California black	2.5	27.6	56.3	11.7	.9	8.28	16.89	3.51	199
Walnuts, California soft shell	2.5	16.6	63.4	16.1	.4	4.98	19.02	4.83	210
Miscellaneous:									
Chocolate	5.9	12.9	48.7	30.3	2.2	3.87	14.61	9.09	183
Cocoa	4.6	21.6	28.9	37.7	7.2	6.48	8.67	11.31	149
Cereal coffee infusion (1 part boiled in 20 parts of water)	98.2	.2	.....	1.4	.2	.06	.....	.42	2
Yeast, compressed	65.1	11.7	.4	21.0	1.8	3.51	.12	6.30	40
Mincemeat, commercial	27.7	6.7	1.4	60.2	4.0	2.01	.42	18.06	84
" homemade	54.4	4.8	6.7	32.1	2.0	1.44	2.01	9.63	62
Soups, homemade:									
Beef	92.4	4.4	.4	1.1	1.2	1.32	.12	.33	8
Bean	84.3	3.2	1.4	9.4	1.7	.96	.42	2.82	19
Chicken	84.3	10.5	.8	2.4	2.0	3.15	.24	.72	18
Clam chowder	88.7	1.8	.8	6.7	2.0	.54	.24	2.01	12

Foods	Percentage Composition					Amount of Organic Food Constituents in 1 ounce (30 grams)			Fuel Value
	% Water	% Protein	% Fat	% Carbohydrates	% Ash	Protein grams	Fat grams	Carbohydrates grams	Calories
Soups, canned:									
Asparagus, cream of	87.4	2.5	3.2	5.5	1.4	.75	.96	1.65	18
Bouillon	96.6	2.2	.1	.2	.9	.66	.03	.06	3
Celery, cream of	88.6	2.1	2.8	5.0	1.5	.63	.84	1.50	16
Chicken gumbo	89.2	3.8	.9	4.7	1.4	1.14	.27	1.41	13
Chicken	93.8	3.6	.1	1.5	1.0	1.08	.03	.45	6
Consommé	96.0	2.5	.....	.4	1.1	.75	.....	.12	3
Corn, cream of	86.8	2.5	1.9	7.8	1.0	.75	.57	2.34	17
Julienne	95.9	2.7	.....	.5	.9	.81	.....	.15	4
Mock turtle	89.8	5.2	.9	2.8	1.3	1.56	.27	.84	12
Mulligatawny	89.3	3.7	.1	5.7	1.2	1.11	.03	1.71	12
Oxtail	88.8	4.0	1.3	4.3	1.6	1.20	.39	1.29	13
Pea	86.9	3.6	.7	7.6	1.2	1.08	.21	2.28	15
Pea, cream of	87.7	2.6	2.7	5.7	1.3	.78	.81	1.71	17
Tomato	90.0	1.8	1.1	5.6	1.5	.54	.33	1.68	12
Turtle	86.6	6.1	1.9	3.9	.5	1.83	.57	1.17	17
Vegetable	95.7	2.9	.....	.5	.9	.87	.....	.15	4

TABLE II[1]

AVERAGE QUANTITIES REQUIRED FOR INDIVIDUAL PORTIONS

Foods	Quantity		*Protein*	*Fat*	*Carbohydrates*	*Calories*[2]
ANIMAL FOODS						
Meat, cooked:	ounces	grams	grams	grams	grams	
Beef, boiled	3.33	100.0	26.2	34.9		
" juice	3.33	100.0	5.0	0.6		
" roast	2.66	80.0	17.84	22.88		
Round steak	3.33	100.0	27.6	7.7		
Sirloin steak	3.33	100.0	23.9	10.2		
Tenderloin, broiled	3.33	100.0	23.5	20.4		
Corned beef, brisket	1.66	50.0	9.15	12.35		
Beef kidneys, stewed	3.33	100.0	18.4	5.1		
" tongue	1.66	50.0	9.45	4.6	2.1	
Veal, leg, boiled	2.33	70.0	14.0	5.0		
" cutlet	2.66	80.0	23.12	1.12		
Lamb, chops (2)	4.0	120.0	26.04	35.88		
" roast	2.66	80.0	15.76	10.16		
Mutton, leg, roast	2.33	70.0	17.50	15.82		
Pork, roast	2.33	70.0	19.88	7.42		
Bacon, uncooked (2 slices)	2.0	60.0	9.30	25.56		
Ham, boiled	1.66	50.0	10.1	11.2		

[1] Computed chiefly from Bulletin No. 28 and No. 142 of the United States Dept. of Agriculture. Unless otherwise specified the figures given are for the edible portion of the foods.

[2] The pupils should estimate the calories according to the directions given on page

Foods	Quantity		Protein	Fat	Carbo-hydrates	Calo-ries
	ounces	grams	grams	grams	grams	
Poultry:						
Capon, roast	3.33	100.0	27.0	11.5		
Chicken, fricasseed	3.33	100.0	17.6	11.5	2.4	
" roast	3.33	100.0	32.1	4.4		
Turkey, roast	3.33	100.0	27.8	18.4		
Fish:						
Bluefish	3.33	100.0	25.9	4.5		
Cod	3.33	100.0	21.68	.27		
Halibut	3.33	100.0	20.35	4.04		
Salmon	3.33	100.0	19.65	10.21		
Shellfish.						
Clams removed from shell (6)	3.00	90.0	9.54	9.9	4.68	
Crabs, hard shell (1)	6.33	200.0	33.20	4.0	2.4	
Lobster	2.33	80.0	13.12	14.4	0.32	
Muscles (12)	3.33	100.0	8.70	1.1	4.1	
Oysters (6)	3.00	90.0	5.40	1.17	2.97	
Scallops	3.33	100.0	14.8	.1	3.4	
Eggs:						
Uncooked (1)	1.66	50.0	6.7	5.25		
Boiled (1)	1.66	50.0	6.6	6.0		
Whites, boiled	1.07	32.0	4.93	.06		
Yolks, boiled	.58	18.0	2.8	5.99		
Dairy Products:						
Butter	.50	15.0	0.15	12.75	......	
Buttermilk	6.00	180.0	5.4	.90	8.28	
Cheese, American	1.00	30.0	8.58	10.77	0.09	
" full cream	1.00	30.0	7.77	10.11	.72	
" Limburger	.66	20.0	4.60	5.88	.08	
" Neufchâtel	1.00	30.0	5.6	8.2	.45	
" Roquefort	0.66	20.0	4.5	5.90	.36	
Cream (average)	0.50	15.0	.375	2.75	.675	
Koumiss	6.00	180.0	5.0	3.78	9.7	
Milk, casein (eiweissmilch)	6.00	180.0	5.4	4.5	2.70	
" condensed, sweetened	0.50	15.0	3.30	1.24	8.11	
" condensed, unsweetened	0.50	15.0	1.44	1.40	1.68	
" skimmed	6.33	200.0	6.8	.6	10.2	
" whole	6.33	200.0	6.6	8.0	10.0	
Whey	3.00	90.0	.9	.27	4.50	
Miscellaneous:						
Gelatin	1 dram	3.8	3.47	0.003	0.0	
Calf's foot jelly	1.66	50.0	2.15	0.0	8.7	
Lard, refined	.50	15.0	0.0	15.0	0.0	
Oleomargarine	.50	15.0	.18	12.45	0.0	
Olive oil	0.50	15.0	0.0	15.0	0.0	
Chocolate	0.50	15.0	1.93	7.3	4.54	
Cocoa	2 drams	7.5	1.61	2.16	2.82	
Soups, homemade:						
Beef	5.0	150.0	6.6	.6	1.65	
Bean	5.0	150.0	4.8	2.1	14.10	
Chicken	5.0	150.0	15.75	1.20	3.60	
Clam chowder	5.0	150.0	2.70	1.20	10.05	
Soups, canned:						
Asparagus, cream of	5.0	150.0	3.75	4.80	8.25	
Bouillon	5.0	150.0	3.30	.15	.30	
Celery, cream of	5.0	150.0	3.15	4.20	7.5	

Foods	Quantity		Protein	Fat	Carbo-hydrates	Calo-ries
	ounces	grams	grams	grams	grams	
Soups, canned—Continued						
Chicken	5.0	150.0	5.4	.15	2.25	
Consommé	5.0	150.0	3.75	0.0	0.60	
Mock turtle	5.0	150.0	7.80	1.35	4.20	
Mulligatawny	5.0	150.0	5.55	0.15	8.55	
Oxtail	5.0	150.0	6.0	1.95	6.45	
Pea, cream of	5.0	150.0	3.90	4.05	8.55	
Tomato	5.0	150.0	2.70	1.65	8.40	
PLANT FOODS						
Cereals:						
Barley meal	0.50	15.0	1.57	0.33	10.92	
Cornflakes	0.75	22.5	2.1	0.09	17.70	
Cornmeal (granular)	0.96	27.0	2.58	0.54	20.35	
Force	0.72	18.0	1.69	0.23	23.86	
Grapenuts	2.18	65.0	7.78	0.39	50.05	
Hominy (cooked)	3.00	90.0	1.98	0.18	16.02	
Oatmeal	0.50	15.0	2.41	1.08	10.12	
" boiled	3.33	100.0	2.8	0.50	11.5	
Rice	1.00	30.0	2.40	0.09	23.7	
" boiled	3.33	100.0	2.8	0.1	24.4	
" puffed	.50	15.0	1.00	0.90	00.9	
Shredded wheat	biscuit	27.0	2.83	0.37	21.03	
Wheat flakes	0.75	22.5	3.01	0.32	16.8	
Wheat flours:						
Entire wheat	1.0	30.0	4.14	0.57	21.57	
Gluten	1.0	30.0	4.26	0.54	21.33	
Graham	1.0	30.0	3.99	0.66	21.42	
Spring wheat flour	1.0	30.0	3.51	0.33	22.35	
Winter wheat flour	1.0	30.0	3.30	0.27	22.32	
Wheat preparations:						
Macaroni (cooked)	3.50	105.0	3.15	1.57	16.59	
Breads:						
Gluten (1 thick slice)	2.0	60.0	5.58	0.84	29.88	
Graham (1 thick slice)	2.0	60.0	5.34	1.08	31.26	
White bread	2.0	60.0	5.58	0.7	31.6	
" " milk	2.0	60.0	5.76	0.8	30.6	
" " Vienna	2.0	60.0	5.64	.72	32.46	
Whole wheat bread	2.0	60.0	5.82	.54	29.82	
Biscuit, homemade (2)	1.25	75.0	6.5	1.99	41.4	
Rolls:						
French rolls (1)	1.33	40.0	3.40	1.0	22.28	
Vienna rolls (1)	1.50	45.0	3.87	.99	25.42	
Crackers:						
Butter crackers (4)	.50	15.0	1.44	1.51	10.74	
Graham crackers (2)	.50	15.0	1.50	1.41	11.07	
Oatmeal crackers (2)	.50	15.0	1.77	1.66	10.35	
Oyster crackers (10)	.33	10.0	1.13	1.05	7.05	
Pretzels (3)	.60	18.0	1.72	.70	13.10	
Saltines (3)	.30	9.0	0.954	1.14	6.16	
Soda crackers (3)	.30	9.0	0.88	.81	6.57	
Water crackers (4)	.33	10.0	1.07	.88	7.19	
Zwieback (2)	1.0	30.0	2.94	2.97	22.05	
Cake:						
Chocolate layer cake	1.50	45.0	2.790	3.64	28.87	

Foods	Quantity		Protein	Fat	Carbo-hydrates	Calories
	ounces	grams	grams	grams	grams	
Cake—Continued						
Coffee cake	1.50	45.0	3.19	3.37	28.48	
Cup cake	1.50	45.0	52.6	4.05	30.82	
Drop cake	1.50	45.0	3.42	6.61	27.13	
Fruit cake	1.50	45.0	2.65	4.90	28.84	
Gingerbread	2.0	60.0	3.48	5.40	38.10	
Johnnycake (cornmeal)	2.0	60.0	4.74	2.82	27.78	
Sponge cake	1.0	30.0	1.89	3.21	19.77	
Lady fingers	0.66	20.0	1.76	1.0	14.12	
Cookies, Wafers, etc.:						
Molasses cookies	0.66	20.0	1.44	1.74	15.14	
Sugar cookies	0.66	20.0	1.40	2.00	14.64	
Fig bars	0.50	15.0	0.69	0.99	10.47	
Ginger snaps	0.66	20.0	1.30	1.72	15.20	
Macaroons	0.50	15.0	0.97	2.28	9.78	
Vanilla wafers	0.66	20.0	1.34	2.80	14.33	
Doughnuts	1.00	30.0	2.01	6.30	15.93	
Jumbles	0.66	20.0	1.48	2.70	12.74	
Pies:						
Apple pie	3.33	100.0	3.1	9.8	42.8	
Custard pie	3.33	100.0	4.2	6.3	26.1	
Lemon pie	3.33	100.0	3.6	10.1	37.4	
Mince pie	3.33	100.0	5.8	12.3	38.1	
Raisin pie	3.33	100.0	3.0	11.3	47.2	
Squash pie	3.33	100.0	4.4	8.4	21.7	
Puddings:						
Indian meal	3.33	100.0	5.5	4.8	27.5	
Rice custard	3.33	100.0	4.0	4.6	31.4	
Tapioca custard	3.33	100.0	3.3	3.2	28.2	
Tapioca and apple	3.33	100.0	.3	.1	29.3	
Sugar, Starches, etc.:						
Honey	1.0	30.0	.12	0.0	24.3	
Arrowroot	.25	7.50	0.0	0.0	7.3	
Cornstarch	.75	22.5	0.0	0.0	20.25	
Sago	.50	15.0	13.50	.06	11.71	
Tapioca	.50	15.0	0.06	.01	13.2	
Sugar, granulated	.25	7.50	0.0	0.0	7.50	
" maple	1.00	30.0	0.0	0.0	24.84	
Syrup, maple	1.00	30.0	0.0	0.0	21.42	
Molasses	1.00	30.0	0.7	0.0	20.79	
Vegetables:						
Artichokes (French, 1)	6.66	200.0	5.2	0.4	33.4	
Asparagus, cooked	4.00	120.0	2.52	3.96	2.64	
Beans, butter	3.33	100.0	9.4	.6	29.1	
" dried	1.00	30.0	6.75	.54	17.88	
" Lima, fresh	3.33	100.0	7.1	.7	22.0	
" string, cooked	3.33	100.0	.8	1.1	1.9	
Beets, cooked	2.33	70.0	1.61	0.07	5.18	
Cabbage	9.33	100.0	1.6	.3	5.6	
Carrots	9.33	100.0	1.1	.4	9.3	
Cauliflower	9.33	100.0	1.8	.5	4.7	
Celery	1.66	50.0	0.55	.05	1.6	
Corn, green	3.33	100.0	3.1	1.1	19.7	
Cucumbers	1.66	50.0	0.4	0.1	1.5	
Eggplant	3.33	100.0	1.2	.3	5.1	
Greens, beet, cooked	3.33	100.0	2.2	3.4	3.2	

Foods	Quantity		*Protein*	*Fat*	*Carbo-hydrates*	*Calo-ries*
	ounce	grams	grams	grams	grams	
Vegetables—Continued						
Lettuce	1.00	30.0	.36	.09	.87	
Mushrooms	1.66	50.0	1.75	.2	3.4	
Onions (cooked)	3.33	100.0	1.2	1.8	4.9	
Parsnips	3.33	100.0	1.6	.5	13.5	
Peas, dried	1.00	30.0	7.38	.30	18.60	
" green, cooked	3.33	100.0	6.7	3.4	14.6	
Potatoes, baked	4.33	130.0	3.77	.20	32.07	
" boiled	5.00	150.0	3.75	.15	31.35	
" cooked, chips	1.66	50.0	3.40	19.90	23.35	
" " mashed	3.33	100.0	2.6	3.0	17.8	
" sweet, cooked	3.33	100.0	3.0	2.1	42.1	
Pumpkins	3.33	100.0	1.0	0.1	5.2	
Radishes	1.00	30.0	0.39	0.03	1.74	
Rhubarb	2.50	75.0	0.45	0.52	2.70	
Spinach, cooked	3.33	100.0	2.1	4.1	2.6	
Squash	3.33	100.0	1.4	0.5	9.0	
Tomatoes	6.66	200.0	1.8	0.8	7.8	
Turnips	3.33	100.0	1.3	0.2	8.1	
Canned Vegetables:						
Artichokes	6.66	200.0	1.6	0.0	10.0	
Asparagus	3.33	100.0	1.5	0.1	2.8	
Beans, baked	3.33	100.0	6.9	2.5	19.6	
" string	3.33	100.0	1.1	0.1	3.8	
" Lima	3.33	100.0	4.0	0.3	14.6	
Brussels sprouts	3.33	100.0	1.5	0.1	3.4	
Corn	3.33	100.0	2.8	1.2	19.0	
Peas	3.33	100.0	3.6	0.2	9.8	
Potatoes, sweet	6.66	100.0	1.9	0.4	41.4	
Pumpkins	3.33	100.0	0.8	0.2	6.7	
Squash	3.33	100.0	0.9	0.5	10.5	
Succotash	3.33	100.0	3.6	1.0	18.6	
Tomatoes	3.33	100.0	1.2	.2	4.0	
Fruit and Berries:						
Apples (1 average size)	5.00	150.0	0.60	.75	21.30	
Apricots (1 average size)	3.33	100.0	1.1	0.0	13.4	
Banana (1)	6.66	200.0	2.6	1.2	44.0	
Blackberries	3.33	100.0	1.3	1.0	10.9	
Cherries	3.33	100.0	1.0	.8	16.7	
Cranberries	1.66	50.0	0.2	0.3	4.9	
Currants	3.33	100.0	1.5	0.0	12.8	
Fig, fresh (1)	4.33	130.0	2.9	0.0	24.4	
Grapes	5.00	150.0	1.95	2.44	28.8	
Huckleberries	3.33	100.0	0.6	0.6	16.6	
Lemon juice	1.00	30.0	0.0	.0	2.9	
Muskmelon ¼	10.00	300.0	1.80	0.0	27.9	
Nectarine (1)	3.33	100.0	0.6	0.0	15.9	
Orange (1)	8.33	250.0	2.0	.5	29.0	
Peach (1)	4.33	130.0	0.91	.13	12.2	
Pear (1)	5.00	150.0	0.90	.75	21.15	
Pineapple (2 slices)	3.33	100.0	0.4	.3	9.7	
Plum (1)	1.66	50.0	0.50	0.0	10.0	
Raspberries, red	3.33	100.0	1.0	0.0	12.6	
Strawberries	3.33	100.0	1.0	.6	7.4	
Watermelon, slice	10.00	300.0	1.2	.6	20.1	
Dried Fruit:						
Apples	1.66	50.0	0.8	1.1	33.0	
Apricots	1.66	50.0	2.35	0.5	31.25	

Foods	Quantity		Protein	Fat	Carbo-hydrates	Calories
	ounce	grams	grams	grams	grams	
Dried fruit—Continued						
Currants	.66	20.0	0.48	0.34	14.84	
Dates	2.33	80.0	1.68	2.24	59.72	
Figs	3.33	100.0	4.3	.3	74.2	
Prunes	3.33	100.0	2.1	0.0	73.3	
Raisins	.80	20.0	0.52	0.66	15.22	
Nuts:						
Almonds (10)	0.50	15.0	3.15	8.23	2.59	
Brazil nuts (5)	1.00	30.0	5.10	20.04	2.10	
Peanuts (8)	0.50	15.0	3.87	5.79	3.66	
Peanut butter	0.50	15.0	4.39	6.97	2.56	
Pecans (7)	0.66	20.0	2.2	14.24	2.66	
Walnuts, Calif. soft shell (5)	0.66	20.0	3.32	12.68	3.22	

List of Vegetables Containing Less than 7% Carbohydrates

(This list is of use in preparing diabetic meals)

	%		%
Asparagus	2.2	Lettuce	2.9
Brussels Sprouts	3.4	Onions	5.5
String beans	6.9	Pumpkins	5.2
Cabbage	5.6	Radishes	5.8
Cauliflower	4.7	Rhubarb	3.6
Celery	3.3	Sauerkraut	3.8
Cucumbers	3.1	Spinach	3.2
Eggplant	5.1	Tomatoes	3.9

Vegetables Containing More than 7% Carbohydrates

	%		%
Artichokes[1]	16.7	Peas, dried	62.0
Beans, butter	29.1	Peas, green	16.9
Beans, Lima	22.0	Potatoes	20.9
Beets	7.7	Squash	10.5
Carrots	9.3	Sweet potatoes	21.9
Corn	19.7	Turnips	8.1
Parsnips	10.8		

[1] The carbohydrate of artichokes being chiefly inulin, this vegetable is used for diabetics.

Foods Particularly Rich in Carbohydrates

The cereals and foods prepared from these as: breakfast foods, macaroni, breads, crackers, cake, cereal puddings
Starches, tapioca, sago.
Potatoes and dried legumes.
Dried fruits.
Chestnuts.
Confectionery.
Honey.
Jellies and preserved fruits.

Foods Rich in Protein

Meats.
Fish.
Poultry.
Eggs.
Milk.
Cheese.
Dried legumes.
Fresh legumes.
Nuts, especially almonds and peanuts.
Macaroni.
Breakfast foods and flours from which the outer coats of the grain have not been removed.

Foods Rich in Fat

Meats mottled with fat.
Pork.
Bacon.
Dark fish, especially salmon, shad, mackerel, eel, turbot, herring.
Butter and cream.
Oils.
Nuts.
Chocolate.

CHAPTER XIII

FEEDING OF INFANTS AND CHILDREN

Difference between Human and Cow's Milk—Modification of Milk—Average Amount of Milk Ingredients Required by Infants at Different Ages—Capacity of Infant's Stomach—Symptoms Considered in Regulating the Feeding of Infants—Diet Regulations for Children.

STATISTICS show that babies nursed by their mothers are not only less liable to diseases of malnutrition during their infancy but are less subject to the so-called "diseases of childhood" and have greater power of resistance in any illness. Next in adequacy to breast milk[1] is pure cow's milk or goat's milk with the proportion of their constituents changed to correspond with those of human milk. The average difference in the composition of cow's and human milk may be seen by the following table.

[1] Now that increased knowledge and laboratory facilities have made it possible to ascertain if individuals are free from infections that could be transmitted to a nursing infant, the habit of employing "wet nurses" is once more becoming common.

DIFFERENCES BETWEEN HUMAN AND COW'S MILK

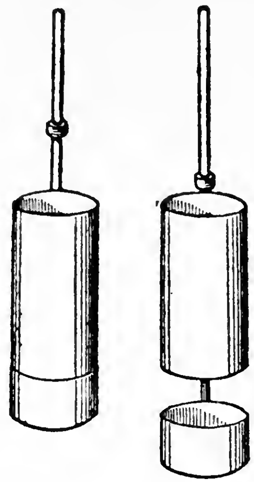
	Human Milk	*Cow's Milk*
Proteid,	1 to 2 per cent.	4 per cent.
Fat,	3 " 4 " "	3 to 4 " "
Lactose,	6 " 7 " "	4.5 " "
Mineral,	1 " 2 " "	.7 " "
Water,	87 " 88 " "	86 to 87 " "

Other important differences between the two milks are: (1) The protein of human milk is two thirds lactalbumin and one third caseinogen, while that of cow's milk is five sixths caseinogen and one sixth lactalbumin; thus human milk coagulates in small flocculent curds instead of in a hard clot, like cow's milk. (2) The fat of cow's milk is not quite the same as that of human milk and is not as easily digested by an infant. (3) Cow's milk is more nearly acid in reaction than human milk.

Modification of Milk.—To make cow's milk more nearly resemble human milk—*i. e.*, to keep the comparative proportion of fat about the same, to decrease the protein, and increase the carbohydrate—several methods are adopted; of these, the following is the most common: The milk, while fresh, is put into sterile quart bottles and allowed to stand until the cream has risen to the top—about six hours. A certain number of ounces of cream, or, as it is often called, top-milk, are then removed,[1] the number depending on the

[1] The best way to do this is to use the new modified Chapin dipper (directions for the use of this are given with the illustration on page 224) or to remove enough milk by siphonage to leave the desired number of ounces of cream in the bottle.

comparative proportion of protein to fat required; thus, if a milk one part protein to three of fat is wanted, a ten per cent. milk will be necessary and



Dipper closed. Dipper open

Fig. 6

The milk dipper is opened at the bottom so that the first ounce of cream can be removed without causing it to overflow from the bottle. The opened dipper is lowered into the cream until its upper edge is just below the upper level of the cream, then the bottom of the dipper is drawn up into place by raising the adjustment on the handle and the first ounce of cream is removed. The remainder of the required quantity of cream can be obtained without opening the dipper, it is simply lowered into the bottle until *its upper edge is just below the upper level of the cream.*

to obtain this the upper ten ounces of cream are skimmed off[1]; while, if a milk one part protein to two of fat is required a seven per cent. milk is

[1] Seven per cent. milk is most frequently used in preparing milk mixtures for infant feeding. The number of ounces of cream necessary to remove to obtain other per cents. can be

needed and the upper sixteen ounces should be removed. The top-milk is then well stirred and as many ounces of it as the prescription calls for measured off. This is then sufficiently diluted

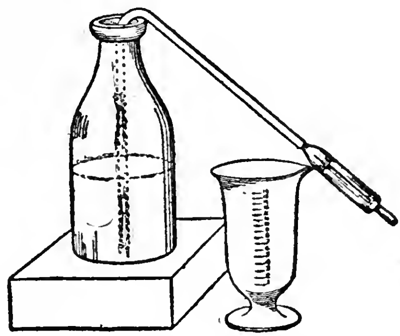


FIG. 7

Showing method of siphoning milk

Milk can be siphoned from under the cream, as shown in the accompanying illustration, by putting one end of a sterile rubber tube into the bottle of milk (it must touch the bottom of the bottle), inserting a syringe, preferably a glass one, in the free end of the tube, and drawing out the piston of the syringe. When the milk is drawn into the syringe, the latter is removed, the end of the tube is put into the graduated measure, and the milk

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seen in the following table. Observe that the cream at the top is richer in fat than that near the milk.

Top	2 oz.	Mixed	24	% Fat	Top	14 oz.	Mixed	7.8	% Fat
“	3 “	“	22.5	“ “	“	16 “	“	7.0	“ “
“	4 “	“	21.4	“ “	“	18 “	“	6.3	“ “
“	5 “	“	19.2	“ “	“	20 “	“	5.8	“ “
“	6 “	“	16.8	“ “	“	22 “	“	5.4	“ “
“	7 “	“	15.0	“ “	“	24 “	“	5.0	“ “
“	8 “	“	13.3	“ “	“	26 “	“	4.7	“ “
“	9 “	“	11.5	“ “	“	28 “	“	4.5	“ “
“	10 “	“	10.0	“ “	“	30 “	“	4.3	“ “
“	12 “	“	9.0	“ “	“	All mixed		4.0	“ “

(Chapin.)

These per cents. are obtained with four per cent. milk.

is allowed to siphon from the bottle until enough is withdrawn to leave just the required amount of top-milk in the bottle; for example, if a seven per cent. top-milk is wanted, 16 ounces must be withdrawn, leaving 16 ounces in the bottle, which, as shown on page 225, will contain seven per cent. fat. The milk drawn into the syringe must be emptied into the graduated measure as this must be reckoned with that withdrawn.

The tube used for this purpose must be rinsed at once in cold water and later washed with hot water. When not in use, it should, like the bottle nipples, be kept in boric acid and it must be sterilized before use.

with cold sterile or cereal water to give the required per cent. of fat.

For several reasons, cereal waters are now much used in infant feeding: (1) they help to make up the deficiency of carbohydrate; (2) they increase the amount of mineral matter; (3) they provide a small quantity of easily digested protein. Malt preparations are often used instead of the plain cereal, because they have the advantage of being partially dextrinized. When other cereals are used, dextrinizing ferments, such as cereo, are frequently added to them. Cereal waters must be very thoroughly cooked in order to partially dextrinize the starch; this is most important, for in infancy the digestive juices contain very little amylolytic ferment. The deficiency of carbohydrate in cow's milk is made up also by adding lactose or maltose to it; the quantity necessary will depend upon the per cent. of cereal in the water.

Formerly lime water was included in milk mixtures as a routine practice in order to make the reaction of cow's milk similar to that of human

milk, but this custom is now less universal, it having been found that the continuous use of lime water or other alkali tends to neutralize the gastric secretion and so interfere with stomach digestion. The milk, it is true, can be prepared for absorption in the intestine, but the natural development of the functions of the stomach are likely to be retarded for lack of use.[1]

Methods of Combining Ingredients.—In preparing milk for infant feeding there are three very important things to bear in mind: To measure accurately, to keep the milk cold, to have all utensils sterile and surroundings absolutely clean.

The ingredients are combined in the following manner: Dissolve the milk sugar in a little sterile water, add the top-milk, and then the cereal or sterile water. Put the amount required for each feeding into a separate bottle. Stopper the bottles with non-absorbent cotton and, unless the milk is to be pasteurized, put the bottles, *at once*, into the ice-box. When the milk is not pasteurized it is well to use sterile bottles and plugs. For pasteurization, see page 134. Before giving the milk to the baby, warm it by standing the bottle in hot water, and then shake the bottle. The temperature of the milk can be tested by shaking a few drops on the inner side of the wrist; it should feel warm, not hot.

[1] *Diseases of Children*, Chapin and Pisek, p. 100, Wm. Wood & Co.

Average of the Various Ingredients Required at Different Ages of an Infant.—As an infant grows and its powers of digestion become more vigorous, it requires a more concentrated food. This is obtained by increasing the amount of milk used in proportion to the water. The following table, which was prepared from the proportions advised by Doctor Holt in his book, *The Care and Feeding of Children*, demonstrates this:

Formula No.	Child's Age	Amount of 7% top-milk	Sugar	Flour	Water
1	2 to 7 days	4 ounces	1 ounce		Enough
2	2 " 3 weeks	4½ "	" "		
3	3 " 4 "	5 "	" "		to
4	4 " 5 "	5½ "	" "		
5	5 " 6 "	6 "	" "		make
6	6 " 8 "	6½ "	" "		
7	8 " 10 "	7 "	" "		20
8	10 " 12 "	7½ "	" "		ounces
9	3 " 4 months	8 "	" "	1 tablesp.	
10	4 " 5 "	9 "	½ "	1½ "	of
11	5 " 6 "	9½ "	" "	" "	the
12	6 " 8 "	10 "	" "	" "	
13	8 " 10 "	10½ "	" "	" "	milk
14	10 " 12 "	11 "	" "	" "	mixture

The sugar is one ounce by weight, which is equivalent to three level tablespoonfuls of lactose or maltose or two level tablespoonfuls of granulated sugar, this being heavier than the other sugars. As a rule, granulated sugar is used only when the other sugars are not available, because it is sweeter and ferments more readily, but it seems to agree with some infants better than lactose and it is much cheaper. Maltose is even more expensive

than lactose, but it is particularly easily digested, and being more laxative than other sugars it is especially valuable when a child is constipated.

The flour may be either that of barley, rice, wheat, arrowroot, or a malted preparation. It is blended into a smooth paste and then further diluted with some of the water and cooked for at least thirty minutes.

Formulas for Whole Milk.—Sometimes, whole milk (four per cent.) is used for milk mixtures, instead of top-milk. The amounts commonly used are about as follows:

Formulas	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Milk (ounces)	6	6½	7	7½	8	8½	9	9½	10	11	12	13	14	15

The same proportions of sugar and flour are used as in the top-milk formula of corresponding number.

When the amount of food required for twenty-four hours is in excess of 20 ounces, the increase, to avoid errors in measuring, should be either to 25, 30, 35, or 40 ounces, as the amount may require, even though this entail a waste of 3 or 4 ounces. To make 25 ounces of any given formula, one quarter more of each ingredient will be required; to make 30 ounces, one half more of each ingredient; for 35 ounces, three quarters; for 40 ounces, double the quantity of all ingredients.

Amounts of Food Required.—The amount of milk mixture that an infant needs depends upon

its age and weight. Though the age of a normal infant is a guide, but not an infallible one, to the best strength for its milk mixtures, its weight is of greater importance in estimating the amount of food that it requires. The reasons for this were discussed in the chapter on Food Requirements. Slightly larger amounts of food are now given at a time than formerly, but the feedings are given less frequently, because it has been found that it requires about three hours for all the milk taken at a feeding to pass from the stomach and this organ needs rest. Also, it would seem that a portion of the liquid of the milk soon passes from the stomach and thus the latter does not become overdistended if the amount of food given is slightly in excess of what has been estimated to be the size of an infant's stomach.

Dr. Holt gives the following estimate for the average amounts needed at different ages, the smaller quantities being, naturally, those for small infants or for those whose power of digestion is not very vigorous.

AGE	*Quantity for one feeding*	*Interval etween feedings during day*	*Hours for night feedings (6 P.M. to 6 A.M.)*	*No. of feedings in 24 hours*	*Quantity of food given during 24 hours*
2d to 7th day	1 to 2 oz.	3 hours	2	7	7 to 14 oz.
2d " 3d week	2 " 3½ "	3 "	2	7	14 " 24 "
4th " 6th week	3 " 4 "	3 "	2	7	21 " 28 "
7th week to 3 mos	3½ " 5 "	3 "	2	7	25 " 35 "
3 " 5 months	4½ " 6 "	3 "	1	6	27 " 36 "
5 " 7 "	5½ " 6½ "	3 "	1	6	33 " 39 "
7 " 12 "	7 " 8½ "	4 "	1	5	35 " 43 "

Especially at first, the increase in amount is not made all at once, but about a quarter of an ounce at a time during the week or month.

Dr. Grulee in his book, *Infant Feeding*, advises that a normal infant, during the first six months of life, be given sufficient food to yield forty-five calories to the pound weight in twenty-four hours, and after six months, enough to yield forty calories to the pound weight. Also, he advocates but five feedings in twenty-four hours between the ages of three and nine months; the feedings to be given at 6 and 10 A.M., 2 and 6 P.M. and midnight until the child is nine months of age, after which the midnight feeding can be changed to 10 P.M. When the number of feedings is thus reduced, the amount of food given at a time must be larger, because the total quantities of milk needed in twenty-four hours, to supply the number of calories advised, will not be less than those given in the above table.

Important Considerations in Infant Feeding.—Not only is the preparation of an infant's food of importance, but also the manner of its administration must be considered. (1) The milk must be kept warm; this can be done by encasing the body of the bottle in a small flannel bag or a soft towel. (2) The bottle must be held while the infant is feeding and held at such an angle that the infant can get its food without exertion, though not too quickly. A baby should not be allowed to take less than ten nor more than twenty minutes for its

meal, and (3) it must not be allowed to sleep while taking its food. (4) The hole in the nipple must be of sufficient size to allow the milk to escape readily in large drops, when the bottle is tilted, but not as a continuous flow.

Symptoms and Causes of Digestive Disturbances.—(1) Vomiting; the common causes of this are: Too much food; taking milk too quickly (this is especially likely to occur when the hole in the nipple is too large); too much fat in the milk; impurities in the milk such as those produced by bacteria; irritated conditions of the gastro-intestinal tract; fondling and playing with the baby too soon after its meal. (2) Colic; this is due to distention of the stomach and intestines with gas. The gas may be air which the infant has swallowed with its food; this it is particularly likely to do if the hole in the nipple is too small. The other common source of gas is fermentation of the milk constituents and this is commonly the result of constipation or of an excess of sugar, starch, or fat in the food, especially sugar. (3) Constipation; this is particularly likely to occur when the fat or sugar content of the food is too low.

Lack of Gain in Weight.—This, unless continuous, is not always indicative of abnormal conditions, especially when there are no other undesirable symptoms. If the child appears to be hungry between meals, failure to gain in weight may mean that it is not getting enough food; thus, it is important to observe if this is the case. When the

failure to gain in weight continues or if there is loss of weight, abnormal symptoms must be watched for and not only the diet but all the conditions of the child's environment and care should be considered.

Diet for Children between 12 and 14 Months. —This is usually about as follows:

6.30 or 7 A.M., 4 per cent. milk, 6 ounces, diluted with 3 ounces of well cooked, strained cereal gruel.

9 A.M., orange juice, one or two ounces.

10 A.M., same as 6.30 A.M.

2 P.M., beef juice, 2 ounces, or strained chicken, beef, or mutton broth, 6 ounces. Well cooked and strained cereal jelly, about 3 to 4 ounces with milk.

6 and 10 P.M., same as 6.30 A.M.

Appropriate Diet between 14 and 18 Months:

7 A.M., milk, 4 per cent., 8 ounces.

9 A.M., fruit juice, preferably orange, about 3 ounces.

10.30 A.M., unstrained, but well cooked cereal, about 3 ounces, with cream 1 ounce or milk 2 ounces. A piece of dry toast or rusk or zwieback. Milk about 6 ounces.

2 P.M., meat broth, about 4 ounces. Either a small baked potato or well cooked rice with a soft cooked egg. A small piece of toast. Water, no milk.

6 P.M., same as 10.30 omitting the toast.

10 P.M., milk, about 6 ounces.

Diet between 18 Months and 2 Years:

This should be the same as the previous diet

with the occasional substitution of finely minced chicken, beef, or white fish for the egg in the 2 P.M. meal and the addition of a small amount (about a level tablespoonful) of mashed and strained carrot or peas or spinach and a desert of either custard or strained cooked prunes or apple sauce.

Also stale bread or toast and milk is added to the 6 P.M. meal and the 10 P.M. meal is omitted.

Very little sugar should be used in cooking fruit for infants and a little salt, but no sugar, should be served with the cereal.

Water should be given between meals.

Diet Regulations for Older Children.—The necessity for care in the feeding of children is not over with infancy. Much of the disease and ill-health of adult life may be traced to errors in the diet of childhood. The following diet regulations are copied from a pamphlet compiled by members of the Vanderbilt Clinic, New York.

1. Articles forbidden children under thirteen years of age:

Food between meals, pies and pastry of all kinds, coffee, tea, beer, cider, alcohol in any form, soda water.

2. Articles forbidden children under seven years:

All those mentioned above, and pork, ham, sausage, salt fish, dried beef, game, kidney, corn, eggplant, cabbage, beets, cucumbers, raw vegetables other than green, fried vegetables; hot bread or hot rolls, griddle cakes, nuts.

3. Articles forbidden children under four years: All those mentioned above and in addition corned beef, bacon, meat stews, tomatoes, sweet cakes, bananas, uncooked berries and cherries, and even other fruit uncooked, other than the juice, must be given with caution, especially in hot weather.

As shown in preceding paragraphs, children between twelve and eighteen months are given nourishment six times in the twenty-four hours and between eighteen months and two years, five times. After they are two years of age, they should have but three meals a day, the heaviest one being in the middle of the day and the last one between five and six in the evening. For three or four years, a glass of milk should be given either between breakfast and dinner or dinner and supper, but apart from this, children should not, ordinarily, be allowed to eat between meals. If for any reason additional nourishment becomes advisable it should be given regularly at a stated hour and should be something that will be easily digested.

CHAPTER XIV

DIET IN DISEASE

Anemia—Cardiac Disease—Constipation—Diarrhea —Diabetes—Fever—Gastritis—Gout—Nephritis —Obesity—Phthisis—Rheumatism—Rickets—Scurvy.

IT is as impossible to fix hard and fast rules for the diet in disease as for any other form of treatment. There are apt to be complications and individual idiosyncrasies to be contended with, and many foods have both advantages and disadvantages to be considered. At the same time in many diseases certain foods are found to be deleterious in the majority of cases. This may be because of: (1) abnormal conditions of one or more of the digestive organs which interfere with the digestion of food as a whole or, sometimes, only with one or other of the food constituents; (2) some abnormal condition that interferes with the utilization or metabolism of one or other of the food principles.

Anemia

Anemia is a condition characterized by a deficiency in red blood-corpuscles, or in hemoglobin,

or in both. It may result from different causes and the cause may entail modifications in the diet, but, ordinarily, a liberal supply of nutritious, easily digested food, relatively rich in iron and other salts is indicated; *e. g.*, milk, eggs, rare beef, beef juice, oatmeal and whole wheat preparations, green vegetables, sweet fruit.

Cardiac Diseases

There are many forms of, and many stages in, cardiac disease, and the physician regulates the diet in accordance with the symptoms. During an acute attack, milk, skimmed if the patient is obese, whole, with perhaps cream added, if he is thin, is the diet usually ordered. If there is any tendency to edema, other fluids are withheld as far as possible and the amount of milk is usually limited to about 36 or 40 ounces (1080 or 1200 cc.) per day. Meat broths, tea, and coffee are generally forbidden, except perhaps in very small amounts, for meat extractives and caffeine excite the heart's action. The transition from milk to solid diet is slow, only one or two easily digested solids, such as soft cooked egg, dry toast, baked potato, white fish or chicken, being given twice or three times a day. While the regular meals are restricted, milk or other nourishment is usually given between meals. As people who have heart lesions are usually forbidden to take much exercise, they often show a tendency to store fat.

Obesity, naturally, entails extension of the blood-vessels and thus calls for extra exertion on the part of the heart in pumping the blood through them; therefore, individuals so troubled should limit their food supply to the amount actually required for the body's nourishment. Constipation should be avoided and, therefore, some coarse food which will leave a large residue to enter the intestine and stimulate peristalsis—see Constipation—is ordered. Foods containing much fat or sugar are not given, especially when there is any tendency to flatulence or other digestive disturbance, as they give rise to such conditions. Highly seasoned foods also are harmful, since condiments such as mustard, ginger, pepper, etc., when absorbed by the blood, act as cardiac irritants. Alcoholic drinks should not be taken, for they favor obesity and may do harm in other ways.

Constipation

Foods likely to stimulate and irritate the intestinal canal should be given, such as:

Farinaceous.—Corn, graham, rye, whole wheat, and bran breads. Oatmeal, cornmeal, wheaten grits, and other coarse cereals.

Vegetables.—Asparagus, cabbage, cauliflower, celery, lettuce, kale, and other greens, onions, peas, spinach, and tomatoes.

Fruits.—Apples, cherries, oranges, pears, peaches, berries, prunes, dates, and figs.

A large amount of water should be taken, especially between meals, and plenty of salt, as this will lessen the absorption of water, and a liberal supply of fat.

Diarrhea

In diarrhea, foods the opposite of those needed in constipation are required; *i. e.*, they should be of a bland, non-irritating nature and not easily fermented, *e. g.*, well-cooked and strained arrowroot, farina, and rice gruels. In chronic diarrhea, such foods as lean meat and fish, potatoes, strained legumes, milk puddings, jellies, and cheese are used, but fat foods and vegetables with much cellulose should be restricted.

Diabetes

In diabetes mellitus, the individual's power to metabolize glucose is impaired to a greater or less extent, the degree varying according to the severity of the disease. The dietetic treatment consists in, after the limit of the patient's carbohydrate tolerance[1] has been found, regulating the diet so that it will contain considerably less carbohydrate than it is found the patient can utilize.

[1] *I. e.*, the amount of carbohydrate he can take without glucose appearing in the urine. This is found by cutting out practically all carbohydrates from the diet until no glucose appears in the urine, and then, day by day, gradually increasing the amount until glucose appears in the urine.

As far as possible, easily digested fats, as fat bacon, butter, cream, salad oils, are used to replace the lacking carbohydrate. Sweetening is done with saccharin and sometimes with levulose, for, though this is an isomer of glucose, it seems to be more easily made use of. Alcoholic drinks, as whiskey and dry (*i. e.*, not sweet) wines are given because, though alcohol is not used for tissue building, it is oxidized in the body, and every gram yields seven calories. It has been found that diabetic patients digest starch of potatoes and oatmeal better than other forms, hence these two articles of food are much used in test work and in special dietaries for diabetics. Usually, only vegetables that contain less than 12 per cent. carbohydrates are used. It is sometimes necessary to restrict proteins, as well as carbohydrates, for, especially when metabolism is interfered with, glucose is formed from them. As a rule, diabetic patients metabolize fats easily; but, when very ill, they sometimes fail to do so and acetone and diacetic acid are formed. The condition is then very serious, acidosis (poisoning by acids) and consequent diabetic coma being likely to follow.

In the preliminary treatment of diabetics, what is known as the *Allen* or *Starvation diet* is now very commonly used. This consists in keeping the patient, when an adult, on a diet of black coffee and whiskey (one ounce of whiskey in about four to six ounces of coffee every two hours from 7 A.M. until 7 P.M.), or, in some cases, bouillon or clear

soups are substituted. Water is given liberally and, if there is acetone or diacetic acid in the urine, sodium bicarbonate is added to counteract the acidosis.

When the patient's urine is sugar-free, his diet is gradually increased. At first not more than about 15 grams of carbohydrate and 10 grams of protein are allowed per day and the calories are kept as low as 200 or 300. If, as the diet is increased, sugar appears in the urine, the preliminary treatment is repeated and, in the subsequent increase, the proteins and carbohydrates are not increased more than avoidable at the same time, in order to determine which of the two foodstuffs is most at fault in promoting the glucosuria.

In the treatment of diabetics, it is particularly important that patients should not be above the average weight normal for their height and thus the diet is usually regulated so that its fuel value will not be, for adults, above 30 calories per kilogram of body weight. Thus, an adult weighing about 58 kilograms would get, on an average, food enough to yield about 1740 calories per day, and this, were the patient doing well, would probably be proportioned as follows: Protein, 50 grams—which would give 200 calories—carbohydrate; 50 grams—200 calories—fat, 150 grams—1350 calories.

Children of about twelve years of age, who have diabetes, after their urine is sugar free, are given food enough to yield about 50 calories per kilogram of body weight; children of about eight are

given sufficient to yield 60 calories per kilogram; and those of about four, sufficient to yield 75 calories per kilogram.

Foods more especially used are: Meat broths, soups without thickening, meat, fish, eggs, green vegetables, string beans, salsify, vegetable marrow, squash, pumpkins, eggplant, rhubarb, tomatoes, cheese, jellies, custards, ice cream, nuts, cream, butter, salad oils.

The amount of carbohydrate in vegetables can be very considerably reduced by changing the water two or three times while they are cooking; boiling water being used to replace that poured off. This is very useful, for it affords the opportunity of maintaining sufficient bulk in the diet to promote intestinal peristalsis without exceeding the carbohydrate allowance.

Fevers

In fevers there is excessive tissue waste, diminished secretion of hydrochloric acid and digestive ferments, and lessened peristaltic action. The dietetic treatment, therefore, must aim to supply sufficient nourishment to counterbalance the great tissue waste and it must be in a form that will be digested and absorbed quickly and easily. Proteins are the essential in tissue repair and an abundance of liquid is also necessary to quench the intense thirst and flush the kidneys of the excessive waste products due to increased metabolism. Milk answers these requirements better

than any other food and should, therefore, form the bulk of the diet in fevers. Meat extracts and broths are given in most cases, for although they contain little nourishment, they give variety and prevent the accumulation of a large residue in the intestines, as is so likely to occur when an exclusive milk diet is maintained. Tea and coffee are sometimes allowed but should never be given without special permission from the physician.

Until recently, a patient running a high temperature, especially when the fever was due to the toxemia of typhoid, was given very little beside milk and broth. Now, however, many physicians advocate a *high calory diet; i. e.*, sufficient food to yield a large number of calories—3000 and over—in order that the products of the food may meet the requirements of the increased oxidation going on in the body and the tissues thus be spared. Cream and lactose are, therefore, sometimes added to the milk and such foods as ice cream, custards, and baked potatoes included in the diet. Eggs, beef juice, and scraped raw beef are very valuable in convalescence as patients are then more or less anemic. When meat is first given it should be minced in order to make it easier to digest.

Gastritis

In gastritis and other stomach disorders, the main points to be considered are: (1) The patient's health; this must not be allowed to become im-

paired and, therefore, as soon as acute symptoms subside, too strict curtailment of the diet is to be avoided. (2) The stomach must have rest; for this reason, it must not be distended even to a degree quite permissible in health, and substances which call for much muscular labor or cause irritation are not to be used.

In order to comply with requirement one without causing an inadvisable degree of distention and muscular effort, the day's food requirement should be divided into four or five, instead of three, portions, and foods that are bulky in proportion to their nutritive value must be used with caution; also, it is more than usually important that food be well masticated.

Substances likely to cause irritation are: Condiments, such as mustard, pepper, spices; alcoholic beverages, especially concentrated ones; coffee; substances which ferment easily, as cane sugar, glucose, and, if used in large amounts, starch; cellulose causes irritation both because of its bulk and because the stomach, when its motor function is impaired, can only dispose of it with difficulty; cooked fats, except that of bacon, may be irritating, for during cooking, acrolein and similar substances may be liberated. On the contrary, butter, cream, pure salad oils, and bacon fats, in moderate amounts, are easily disposed of.

When there is an excessive secretion of hydrochloric acid, animal foods, as milk, casein preparations, such as those described on page 141, and

eiweissmilch (see recipe, p. 358), cream, eggs, white fish, lean meat, and gelatin deserts should form a large portion of the diet, for their protein unites with the acid and animal foods are free from cellulose and easily fermentable carbohydrates. Meat, however, should be used to a less extent than the other articles mentioned because it tends to stimulate the secretion of acid. Lactose is sometimes used instead of cane sugar as it does not ferment so readily. Weak tea can be used, but not coffee, for the extractive matter in the latter is particularly likely to encourage the secretion of acid; alcoholic drinks are prohibited for the same reason and, also, sour, sweet, spiced, salty, very hot and very cold foods and those with much cellulose.

The fats specified on page 244 should be freely used as they check the secretion of acid. Sweet butter is better than salted; if the latter is used, it should be pressed and manipulated in water to extract the salt.

The only vegetables allowed are baked potatoes (these can be served in different ways) and green vegetables—other than cabbage—boiled until soft, and even these must be used in moderation.

The fine cereals, as cream of wheat and farina, can be taken in small amounts, also rice, sago, tapioca, macaroni, toast, zweiback, and crackers.

Only sweet fruit well cooked, with but little sugar, should be eaten.

During severe acute attacks of gastric disorders

the diet is restricted to bland liquid foods such as egg albumen, barley water, milk. The latter is often peptonized or otherwise treated as described on page 129, to facilitate its digestion. Sometimes, it is even necessary to discontinue giving food by mouth and give it by rectum. In such case, the food must be liquid and predigested, for the large intestine does not secrete any digestive juice. For methods of preparing enemata, see page 259.

Gastric Ulcer

Formerly, very little nourishment was given by mouth to patients suffering with gastric ulcer, but, as it has been lately demonstrated that the acidity of the gastric juice is increased by this treatment and the ulcerative process favored by the hyperacidity, many physicians now feed their patients even after they have had a hemorrhage.

The Lenhartz diet, in which the quantity of food is gradually increased, is a form of feeding frequently used.

Lenhartz Diet

General Directions

Days one to ten, feedings every hour.

Days eleven to fourteen, feedings every two hours.

Feedings omitted from 7 P.M. until 7 A.M.

Water allowed at intervals in moderate quantities.

Eggs being of different sizes, it is well to take the total number for the day, break and beat them in a graduated glass measuring cup, and take one seventh or, beginning day seven, one third of the total amount for each feeding. On days one and two salt the egg to taste.

The scraped beef is given raw, the chicken cooked.

Day I. Milk, 20 cc. ($\frac{2}{3}$ oz.) every two hours (total for day 100 cc.); raw egg, $\frac{1}{7}$ part of two eggs, on alternate hours.

Day II. Milk, 30 cc. (1 oz.) every two hours (total for day 200 cc.); raw egg, $\frac{1}{7}$ part of 3, on alternate hours.

Day III. Milk, 50 cc. ($1\frac{2}{3}$ oz.) every two hours (total for day 300 cc.); raw egg, $\frac{1}{7}$ part of 4, with sugar 3 gm. on alternate hours.

Day IV. Milk, 70 cc. ($2\frac{1}{3}$ oz.) every two hours (total for day 400 cc.); raw egg, $\frac{1}{7}$ part of 5, with sugar 3 gm. on alternate hours.

Day V. Milk, 80 cc. every two hours (total for day 500 cc.); $\frac{1}{7}$ part of 6 eggs, with sugar 4 gm. on alternate hours.

Day VI. Milk, 100 cc. every two hours (total for day 600 cc.); raw egg, $\frac{1}{7}$ part of 7, with sugar $4\frac{1}{2}$ gm. on alternate hours.

Day VII. 7 A.M. 1 soft boiled egg.

8 A.M. Milk, 100 cc. ($3\frac{1}{3}$ oz.).

9 A.M. Raw egg, $\frac{1}{3}$ part of 4, with sugar 13 gm.

10 A.M. Milk, 100 cc.; scraped beef, 23 gm.; boiled rice, 33 gm.

11 A.M. 1 soft boiled egg.

12 noon. Milk, 125 cc.

1 P.M. Raw egg, $\frac{1}{3}$ part of 4, with sugar 13 gm.
2 P.M. Milk, 125 cc.; scraped beef, 23 gm.; boiled rice, 33 gm.
3 P.M. 1 soft boiled egg.
4 P.M. Milk, 125 cc.
5 P.M. Egg, $\frac{1}{3}$ part of 4 eggs, with sugar 14 gm.
6 P.M. Milk, 125 cc.; scraped beef, 24 gm.; boiled rice, 34 gm.
7 P.M. 1 soft boiled egg.

Day VIII. 7 A.M. 1 soft boiled egg.
8 A.M. Milk, 135 cc.
9 A.M. Raw egg, $\frac{1}{3}$ part of 4, with sugar 13 gm.
10 A.M. Milk, 133 cc.; scraped beef, 23 gm.; boiled rice, 33 gm.
11 A.M. 1 soft boiled egg; zwieback, 10 gm.
12 noon. Milk, 133 cc.
1 P.M. Raw egg, $\frac{1}{3}$ part of 4, with sugar 13 gm.
2 P.M. Milk, 133 cc.; scraped beef, 23 gm.; boiled rice, 33 gm.
3 P.M. 1 soft boiled egg.
4 P.M. Milk, 133 cc.
5 P.M. Raw egg, $\frac{1}{3}$ of 4; sugar, 14 gm.; zwieback, 10 gm.
6 P.M. Milk, 133 cc.; scraped beef, 24 gm.; boiled rice, 34 gm.
7 P.M. 1 soft boiled egg.

Day IX. 7 A.M. 1 soft boiled egg.
8 A.M. Milk, 150 cc.
9 A.M. Raw egg, $\frac{1}{3}$ part of 4, with sugar, 13 gm.
10 A.M. Milk, 150 cc.; scraped beef, 23 gm.; boiled rice, 66 gm.
11 A.M. 1 soft boiled egg; zwieback, 20 gm.
12 noon. Milk, 150 cc.
1 P.M. Raw egg, $\frac{1}{3}$ part of four, with sugar, 13 gm.

2 P.M. Milk, 150 cc.; scraped beef, 23 gm.; boiled rice, 67 gm.

3 P.M. 1 soft boiled egg; zwieback, 20 gm.

4 P.M. Milk, 150 cc.

5 P.M. Raw egg, $\frac{1}{3}$ part of 4, with sugar 14 gm.

6 P.M. Milk, 150 cc.; scraped beef, 24 gm.; boiled rice, 67 gm.

7 P.M. 1 soft boiled egg.

Day X. 7 A.M. 1 soft boiled egg.

8 A.M. Milk, 166 cc.

9 A.M. Raw egg, $\frac{1}{3}$ part of 4, with sugar, 13 gm.

10 A.M. Milk 168 cc.; scraped beef, 23 gm.; boiled rice, 66 gm.

11 A.M. 1 soft boiled egg; zwieback, 20 gm.; butter, 4 gm.

12 noon. Chopped chicken, 25 gm.; milk, 166 cc.

1 P.M. Raw egg, $\frac{1}{3}$ part of 4, with sugar, 13 gm.

2 P.M. Milk, 166 cc.; scraped beef, 23 gm.; boiled rice, 66 gm.; butter, 4 gm.

3 P.M. 1 soft boiled egg; zwieback, 20 gm.; butter 4 gm.

4 P.M. Chopped chicken, 25 gm.

5 P.M. Raw egg, $\frac{1}{3}$ part of 4, with sugar, 14 gm.

6 P.M. Milk, 166 cc.; scraped beef, 24 gm.; boiled rice, 67 gm.; butter, 4 gm.

7 P.M. 1 soft boiled egg.

Day XI. 7 A.M. 1 soft boiled egg; milk, 250 cc.; zwieback, 10 gm.; butter, 4 gm.

9 A.M. Raw egg, $\frac{1}{3}$ of 4, with sugar, 13 gm.; scraped beef, 20 gm.; boiled rice, 75 gm.; zwieback, 10 gm.

11 A.M. 1 soft boiled egg; milk, 250 cc.; butter, 6 gm.; zwieback, 10 gm.

1 P.M. Raw egg, $\frac{1}{3}$ part of 4, with sugar, 13 gm.; chopped chicken, 25 gm.; boiled rice, 75 gm.

3 P.M. 1 soft boiled egg; milk, 250 cc.; scraped beef, 20 gm.; boiled rice, 75 gm.; zwieback, 10 gm.; butter, 6 gm.

5 P.M. Raw egg, $\frac{1}{3}$ part of 4, sugar, 14 gm.; chopped chicken, 25 gm.; boiled rice, 75 gm.; butter, 6 gm.

7 P.M. 1 soft boiled egg; milk, 250 cc.; zwieback, 10 gm.; scraped beef, 30 gm.

Day XII. 7 A.M. 1 soft boiled egg; milk, 250 cc.; zwieback, 10 gm.; butter, 4 gm.

9 A.M. Raw egg, $\frac{1}{3}$ of 4, sugar 13 gm.; scraped beef, 35 gm.; boiled rice, 75 gm.; zwieback, 10 gm.; butter, 6 gm.

11 A.M. 1 soft boiled egg; milk, 250 cc.; zwieback, 20 gm.; butter, 6 gm.

1 P.M. Raw egg, $\frac{1}{3}$ of 4, sugar, 13 gm.; chopped chicken, 25 gm.; boiled rice, 75 gm.; zwieback, 10 gm.; butter, 6 gm.

3 P.M. 1 soft boiled egg; milk, 250 cc.; scraped beef, 35 gm.; boiled rice, 50 gm.; zwieback, 10 gm.; butter, 6 gm.

5 P.M. Raw egg, $\frac{1}{3}$ part of 4, sugar, 14 gm.; chopped chicken, 25 gm.; boiled rice, 75 gm.; zwieback, 10 gm.; butter, 6 gm.

7 P.M. 1 soft boiled egg; milk, 250 cc.; zwieback, 10 gm.; butter, 6 gm.

Day XIII. 7 A.M. 1 soft boiled egg; milk, 142 cc.; zwieback, 10 gm.; butter, 4 gm.

9 A.M. Raw egg, $\frac{1}{3}$ of 4, sugar 13 gm.; milk, 142 cc.; scraped beef, 20 gm.; boiled rice, 75 gm.; zwieback, 20 gm.; butter, 6 gm.

11 A.M. 1 soft boiled egg; milk, 144 cc.; zwieback, 10 gm.; butter, 6 gm.

1 P.M. Raw egg, $\frac{1}{3}$ of 4, sugar, 13 gm.; milk, 142 cc.; chopped chicken, 25 gm.; boiled rice, 75 gm.; zwieback, 10 gm.; butter, 6 gm.

3 P.M. 1 soft cooked egg; milk, 144 cc.; scraped beef, 20 gm.; zwieback, 10 gm.; butter, 6 gm.

5 P.M. Raw egg, $\frac{1}{3}$ of 4, sugar, 14 gm.; milk, 142 cc.; chopped chicken, 25 gm.; boiled rice, 75 gm.; zwieback, 10 gm.; butter, 6 gm.

7 P.M. 1 soft cooked egg; milk, 144 cc.; zwieback, 10 gm.; butter, 6 gm.

Day XIV. Same as day thirteen.

Gout

Gout is characterized by defective metabolism and an excess of uric acid in the system. Consequently, the principal foods withheld, or given in reduced amounts, are those which contain substances that give rise to uric acid in the course of metabolism. Foods coming under this heading are: (1) glandular organs, such as sweetbreads, the cells of which are highly nucleated[1]; (2) meats and plants containing comparatively large proportions of extractives; those substances consisting largely of purin bodies or their precursors that have been formed in the course of metabolism and growth. Beef, tea, and coffee are especially rich in extractives (see page 94). The

[1] It will be remembered that the purin bodies from which uric acid is formed are derived from the protein constituents of the nuclei of cells.

amount of extractives in meat can be very much diminished by boiling the meat, especially if the water is changed during the process. Since the extractives are drawn out in this way, meat broths, soups, and extracts contain large amounts of such substances. Acids of all kinds are forbidden and also wines and all highly seasoned food and those that the individual does not digest easily.

Purin free foods should form a large portion of the diet; among these are: Milk, cream, eggs, butter, farina, hominy, rice, tapioca, cornstarch, cabbage, cauliflower, eggplant, lettuce, salad oil, cheese, nuts, also custards, ice creams, water ices, bread, crackers, and other made dishes containing the foregoing ingredients. Potatoes and boiled meats contain but small amounts of purins.

Nephritis

It is through the kidneys that the greatest part of the nitrogenous waste matter and of salts is eliminated from the body. When the kidneys are diseased, however, they often fail to do their work thoroughly and thus there is a tendency for these substances to accumulate in the body. The retention of protein waste is likely to lead to uremia and that of salts to the retention of water and consequent edema. For this reason, as well as to give the kidneys as little work as possible, foods containing a comparatively high per cent. of protein, as meat, fish, eggs, beans,

and peas, are only given in small amounts and, if there is any tendency to edema, sodium chlorid is eliminated from the diet and liquids are restricted. As a rule, milk or milk gruels constitute the main part of the diet during an acute attack of the disease.

Obesity

The daily allowance of food is cut down to about two thirds or, for a short time, half the usual amount, and foods that have the lowest caloric value in proportion to their bulk are used. The bulk is necessary to avoid constipation and, partly by psychic influence, it helps to prevent the patient feeling hungry. The foods more especially used are the green vegetables and others containing less than seven per cent. carbohydrates (see table, Chapter XII.), lean meat, white fish, eggs, buttermilk. Sugars and foods containing a large per cent. of fat are not to be used.

Sometimes, at the beginning of the treatment, for a few days, the patient is given nothing but skimmed milk or buttermilk, about one quart per day, and water.

Acute Rheumatic Fever

This is a disease of bacterial origin, one characteristic of which is an accumulation of acid in the system. While there is any fever, milk made

alkaline by the addition of lime water constitutes the principal part of the diet. During convalescence, very much the same kind of food is given as is used in the treatment of gout. Candy and similar substances are prohibited.

Tuberculosis

The most important characteristic of this disease as regards its dietary treatment is the excessive tissue waste. On account of this waste, it is necessary to give more food than under normal conditions and in order to do so without overloading the stomach two things are essential: (1) nourishment must be given between meals; (2) as much food with a high caloric value must be used as possible without causing digestive disturbances; *e. g.*, bacon, butter, salad oil, eggs, and milk, the latter either in its natural form, or as buttermilk, kumyss, matzoon, junket, should form a large portion of the between-meal nourishment.

Rickets

The dietetic cause of rickets is lack of fat, calcium salts, and protein and an excess of carbohydrate in the food. Starchy foods are therefore restricted and foods rich in protein, fat, and salts are given in larger amounts than usual. Young babies who are bottle fed are given properly

modified milk. Older children are given milk, which contains a larger amount of calcium than other foods, eggs, beef tea, mutton broth, fresh fruit juice, especially orange juice, and if the child is old enough to have them, rare meat and vegetables.

Scurvy

The chief dietetic cause is a lack of fresh vegetables or, in infants, the prolonged use of condensed or sterilized milk, or proprietary foods which are lacking in mineral matter. Infants and also older patients who are in bad condition are fed on orange juice, beef juice, and milk. During convalescence, those who are old enough are given rare meats, fresh fruit, and vegetables, especially potatoes and the green vegetables.

Some Special Diets

A low calcium diet is sometimes used in the disease known as *arthritis deformans*, because the calcium, it is thought, helps to promote the stiffening of the joints. The foods generally allowed are: White breads, butter, boiled meats and fish, potatoes, apples, sugar, tea with cream.

A farinaceous diet is one in which a minimum of nitrogenous matter is given and it consists largely of starch foods such as the cereals, white breads, crackers, and other cereal preparations and sago. Fruit and the green vegetables, and

the roots and tubers are generally allowed, but not the legumes. Cream, butter, milk and, sometimes, eggs, are also, as a rule, included in the diet.

A nitrogenous diet includes the animal foods—meat, fish, eggs, milk, cheese, cream, butter—and, as a rule, the green vegetables; oatmeal is sometimes allowed and small amounts of breads and crackers made with bran, gluten, soy, and graham flours, and also salad oils. It is the starches and sugars that are to be eliminated as far as possible.

A purin free diet is one from which the following articles are eliminated: All meat, fish, fowl, game, and foods prepared from them as meat soups and broths, gravies, etc., the legumens, asparagus, onions, oatmeal, tea, coffee, and malt liquors. The foods used are vegetables, except those just mentioned, milk, cheese, eggs, bacon fat, soups made from vegetables and milk soups, cereals, except oatmeal, breads and crackers made from white flours, not from graham, bran, or whole wheat. The origin of the purin was mentioned on page 31.

The Salisbury diet consists of minced lean meat and hot water. The meat is thoroughly cooked and minced and is given three times a day. The hot water—about 120° F.—is given four times a day about one and one half hours before each meal and three hours after the last meal. This diet is sometimes used in gout and in some skin diseases.

A so-called **salt free diet** is one in which sodium chlorid is eliminated as far as possible. Almost

all foods are used, but salt is not added either during cooking or at meal time. The meats, fish, and vegetables are boiled and the water changed two or three times (boiling water being used to replace that poured off); this, as sodium chlorid is soluble in water, extracts the greater part of the salt. The reason for a salt free diet was given under nephritis.

Test Meals

For diagnostic purposes, certain foods for which the time required for digestion is well known are given and, later, the residue of those used to determine gastric disturbances is removed by the use of the stomach tube. Defects in intestinal digestion and absorption are ascertained by examination of the feces and urine.

The object of the almost universal use of certain special meals for diagnostic purposes is, not that the foods chosen have any special virtue in themselves, but that the use of standard diets allows of comparison of results which is of great importance in diagnoses and scientific study.

The following are some test meals frequently used, either as here described or with slight modifications:

Gastric Test Meals

Ewald's Test Meal.—White bread or rolls (no crust), 40 gm. (1½ oz.) and water or clear tea, 400 cc. (6 oz.).

No butter, sugar, milk, or cream. The stomach contents are expressed one hour after giving the meal.

Leube's Test Meal.—Clear soup, 200 cc. (13½ oz.); beefsteak, 200 gm. (6⅔ oz.); bread, 50 gm. (1⅔ oz.). water, 200 cc. (6⅔ oz.).

Expressed in six hours.

Riegel's Test Meal.—Mutton broth, 200 cc.; beefsteak, 200 gm.; mashed potato, 50 gm.; bread or roll, 50 gm.; water, 200 cc.

Expressed in six hours.

Schmidt's Intestinal Diet

Breakfast. Milk, ½ liter or an equal quantity of cocoa made with milk; egg, 1, soft cooked or raw; zwieback or roll, 50 gm.; butter, 10 gm.

Forenoon. ½ liter of oatmeal gruel made from oatmeal, 40 gm., water, 200 cc., and milk, 300 cc.

Dinner. Chopped beef, 125 gm. (4 oz. weighed when raw), lightly broiled with butter, raw inside; strained potato purée made from mashed potato, 190 gm. (6⅓ oz.); milk, 100 cc., and butter, 10 gm. (⅓ oz.).

Afternoon. Same as breakfast.

Supper. Same as forenoon.

This diet is usually maintained for about three days. All the food used must be weighed or measured *absolutely* accurately. Should the patient not eat the entire amount, that not used must be weighed or measured. All the urine and feces passed after a stated time are measured and sent to the laboratory for analysis. It is also

sometimes required that specimens of the foods used be sent to the laboratory for analysis.

Rectal Feeding

Under some conditions, especially those mentioned under gastritis, rectal feeding has to be resorted to. The following are examples of enemata used for this purpose:

Recipes for Nutritive Enemata

(1) A nutritive enema much used at the present time consists of fully peptonized milk, 8 ounces, and either maltose or glucose, 1 to 1½ ounces.

The milk should be first scalded and then peptonized according to the directions given in the recipes, for at least two hours, and then rescalded to destroy the ferment. If the milk is not wanted at once, it should be kept in the ice-box.

(2) Fully peptonized milk, 8 ounces; glucose or maltose, 1½ ounces; beef peptone, ½ ounce.

If the peptone is not in liquid form it is dissolved in a small amount of hot water, the glucose is added, and then, slowly, the milk. Egg, either the white alone or the whole egg, is sometimes added to this form of enema, though not as commonly as formerly for it is thought that it interferes with the absorption of the enema.

There are some very essential points to be remembered in connection with the administration of nutritive enemata. (1) The intestine must

not be irritated or peristalsis will be increased and the enema expelled; to avoid this, the food must be about the internal body temperature (100° F.), the enema must be given slowly, and a small, well lubricated tube used. (2) To facilitate the absorption of the food, which is but incomplete when given in this way, under the most advantageous circumstances, the intestine must be kept as free as possible from residue. For this reason a cleansing enema is usually administered daily. (3) The cleansing enema must not be given shortly before or soon after a nutritive enema.

CHAPTER XV

MISCELLANEOUS

Weights and Measures and Table of Equivalents—Chemical Symbols—Methods of Cooking—Methods of Preparing Food—Rules for Measuring—Ways of Combining Ingredients—Utensils—Methods of Preserving—Common Adulterations of Foods—Serving Food.

Weights and Measures

Avoirdupois Weight

Troy grains (gr.)		*Drams* (dr.)		*Ounces* (oz.)		*Pound* (lb.)		*Metric Equivalent* Grams
27.34375	=	1					=	1.7705
437.5	=	16	=	1			=	28.328
7000.	=	256	=	16	=	1	=	453.25

Apothecaries' Measures

60 minims (♍)....=1 fluid drachm, 1 f ʒ
8 fluid drachms...=1 fluid ounce, 1 f ℥
16 fluid ounces....=1 pint, pt.
2 pints..........=1 quart, qt.
4 quarts.........=1 gallon, gal.

Metric System.—The metric system of weights and measures, being more convenient and accurate

than the apothecaries' system, is now gradually being adopted in this country. It originated in France in 1790, and has been accepted in all European countries except England where, as in this country, it is still optional.

The meter is the unit of length, the gram of weight, and the liter of volume. A gram is the weight of a cubic centimeter of water at its greatest density, 4° Centigrade. A liter is the volume of a cubic decimeter of water at 4° Centigrade.

The prefixes deca-, hecto-, and kilo-, derived from the Greek numerals, are used to denote increase, and the prefixes deci-, centi-, and milli-, derived from the Latin numerals, to denote decrease.

1000	=	1 kilometer.
100	=	1 hectometer.
10	=	1 decameter.
1	=	1 meter.
.1	=	1 decimeter.
.01	=	1 centimeter.
.001	=	1 millimeter.

The cube of a centimeter is called a cubic centimeter and is written 1 cc. With the exception of the centimeter the numerals denoting decrease are rarely used and when speaking of one cubic decimeter, we say 1000 cc. In stating capacity, instead of giving the subdivisions for the liter we use cubic centimeters, as 100 cc. instead of one deciliter and 10 cc. instead of one centiliter.

Table of Metric Equivalents

1 meter	=	39.37 inches.
25 millimeters	=	1 inch.
1 liter	=	33.81 fluid ounces or 1.056 quarts.
1 gram	=	15.43 grains.
.065 grams	=	1 grain.
29.37 cc.	=	1 fluid ounce.
1 cc.	=	16 minims.

Thermometers.—The thermometer in scientific use is the Centigrade with boiling point of water 100° and freezing point 0°.

The thermometer in popular use is the Fahrenheit with boiling point of water at 212° and freezing point 32° above zero.

To change Fahrenheit degrees to Centigrade subtract 32° and multiply remainder by $\frac{5}{9}$:

$$212^\circ - 32^\circ = 180^\circ;\ 180^\circ \times \tfrac{5}{9} = 100^\circ.$$

To change Centigrade degrees to Fahrenheit multiply by $\frac{9}{5}$ and add 32° to the product:

$$100^\circ \times \tfrac{9}{5} = 180^\circ;\ 180^\circ + 32^\circ = 212^\circ.$$

Chemical Abbreviations

The abbreviations used in chemistry for the common elements and substances consist of the initial letter of the Latin name of the element and sometimes one or two other letters are used. When two or more elements have the same initial letter the single letter is given to the most common element.

Common Elements and Symbols

Aluminum	Al	Manganese	Mn
Arsenic	As	Mercury (Hydrargyrum)	Hg
Calcium	Ca	Nitrogen	N
Carbon	C	Oxygen	O
Chlorine	Cl	Phosphorus	P
Gold (Aurum)	Au	Potassium	K
Hydrogen	H	Silver (Argentum)	Ag
Iodine	I	Sodium (Natrium)	Na
Iron (Ferrum)	Fe	Sulphur	S
Lead (Plumbum)	Pb	Tin (Stannum)	Sn
Magnesium	Mg		

Common Substances and Symbols[1]

Acetic Acid	$C_2H_4O_2$
Alcohol	C_2H_5OH
Alcohol (Wood)	CH_3OH
Ammonium (Gas)	NH_3
Ammonium Hydrate (Aqua Ammonia)	NH_4OH
Aqua Calcis (Lime Water)	$Ca(OH)_2+H_2O$
Benzine	C_6H_6
Calcium Carbonate	$CaCO_3$
Carbon Dioxide	CO_2
Carbon Monoxide	CO
Carbonic Acid	H_2CO_3
Caustic Soda	$NaOH$
Caustic Potash	KOH
Cellulose	$C_6H_{10}O_5x$
Hydrochloric Acid	HCl
Potassium Chlorate	$KClO_3$
Potassium Nitrate (Saltpeter)	KNO_3

[1] Each letter represents but one atom of the corresponding element. When the substance contains more than one atom the number of atoms is written after and below the letter.

Potassium Tartrate (Cream of Tartar)	$12C_4H_5O_6$
Sodium Bicarbonate	$HNaCO_3$
Sodium Carbonate (Washing Soda)	$Na_2CO_3.10H_2O$
Sodium Chloride (Common Salt)	$NaCl$
Starch	$C_6H_{10}O_5x$
Sugar (Cane)	$C_{12}H_{22}O_{11}$
Sugar (Grape)	$C_6H_{12}O_6$
Sugar (Milk)	$C_{12}H_{22}O_{11}$
Tartaric Acid	$C_4H_6O_6$
Water	H_2O

Methods of Cooking

Baking is cooking in an ordinary oven. Meats so cooked are generally, though erroneously, called roasted.

Boiling is cooking in boiling water. A mistake is commonly made in thinking that when water boils rapidly it will cook food more quickly. Water at sea level boils at 212° F. or 100° C. and slowly boiling water is of the same temperature as that boiling rapidly, since, in the latter case, there is a greater loss of heat due to the rapid vaporization.

Braising is a combination of stewing and baking and, as a rule, sautéing. The meat is first sautéd to prevent escape of juices and then together with stock, herbs, and vegetables put into a closely covered pan and cooked in a slow oven for some hours. The liquid should simmer, not boil.

Broiling or grilling is cooking over, under, or in front of a clear fire or flame. The heat should

quickly sear the surface to keep in the juices. Pan broiling is cooking meat in a very hot frying-pan. The meat should be turned frequently.

Frying is cooking in deep fat at a temperature of 350° to 400° F., the degree depending upon the food to be cooked. The temperature of the fat is very important; if not sufficiently hot to form a crust or coating on the food it will be absorbed, and if too hot the surface of the food will burn before the center is cooked. To ascertain if the fat is hot enough, when it begins to smoke drop in a piece of white bread; if the bread becomes a golden brown in forty seconds the fat is sufficiently hot for frying food made from cooked material, also for fish and oysters. If it takes one minute for it to brown, the fat is right for fritters and other uncooked articles.

The fats used for frying are olive oil, lard, suet, beef drippings, and preparations of vegetable oils. Olive oil is one of the best, but it is too expensive for common use. A combination of one third beef suet and two thirds lard is often used and is generally preferred to all lard.

To try out fat, cut the fat in small pieces and melt in a double boiler or kettle placed on the back of the range. When melted strain.

To clarify fat after the fat is tried out and strained, add a raw potato cut in slices and heat gradually. When the fat ceases to bubble and the potato is well browned, strain it through doubled cheesecloth. Fat may be used several

times if thus clarified as the potato collects any sediment that may be in the fat and also absorbs all gases and odors.

Fricasseeing is sautéing meat and then covering it with a sauce. Tough meat and veal require to be simmered for some time either before or after sautéing.

Roasting is similar to broiling but the heat is concentrated by means of a reflector. Thicker pieces of meat are used than for broiling. The meat must be turned and basted frequently, especially until the surface is seared. It is held near the flame for the first six or ten minutes and then removed to a greater distance and cooked more slowly.

Sautéing is cooking in a small amount of fat in a frying-pan or griddle. Sautéd food is not as digestible as fried, it being almost impossible to prevent its absorbing a considerable amount of fat. In sautéing the food should be put into the pan as soon as the fat begins to boil; if put in too soon it will absorb the fat, and if the fat is cooked too long it will become decomposed and will impart an unpleasant flavor to the food.

Methods of Preparing Food for Cooking

Egging and Crumbing.—Many foods are covered with a coating of egg and crumbs before being fried. This prevents the fat soaking into the food, because the intense heat coagulates the

albumen of the egg and forms a protective coating over its surface.

To prepare the egg, beat it just enough to blend the yolk and white and add two tablespoons of cold water.

Dried bread crumbs rolled and sifted and seasoned with pepper and salt are best for the crumbing. Roll the food in the crumbs, taking care that all parts are covered; this dries its surface and the egg then adheres better. Next dip the food in egg, and, lastly, in the crumbs again.

Larding is introducing strips of salt pork or bacon under the surface of lean meat, birds, or fish. Chill the pork, remove rind, and cut strips from the firm fat immediately underneath. These strips, called lardoons, are about a fourth of an inch thick and two inches long. If for larding small birds, they are cut smaller. The lardoons must be cold when used. Insert end of lardoon in split end of larding needle and take a stitch about one third inch deep and one inch long. As the needle comes through hold the free end of the lardoon so that it will remain in the meat when you pull out the needle.

Boning is removing all the bones from the fish, fowl, or bird, leaving the flesh entire. In boning a bird or fowl the flesh is removed from the frame beginning at the backbone and working down toward the breast, taking care to free the meat from the wings and legs, drawing it off from them like

a glove. The flesh is then put in as nearly the original shape as possible.

Rules for Measuring

Always measure accurately. In the recipes in this book a cupful, teaspoonful, etc., should always be measured level.

When measuring dry ingredients level the surface with the flat edge of the knife. For a half spoonful divide the substance lengthwise of the spoon. For a quarter spoonful divide the half crosswise. In measuring dry ingredients the measure should never be packed or shaken down but the ingredients should be sifted or made light and free from lumps before measuring.

When measuring butter, lard, etc., pack solidly into the measure and level with a knife.

Dry ingredients are measured first, next the butter and like substances, and the liquids last; one cup can be used for all the measuring. Graduated cups or cups marked in thirds and quarters and the regulation size teaspoon and tablespoon should be used; basting and mixing spoons, which are of no standard size, should never be used.

Table of Measures

3 teaspoons. .	= 1 tablespoon.
4 tablespoons	= $\frac{1}{4}$ cup.
16 tablespoons	= 1 cup.
4 cups.	= 1 quart.

Equivalent Measures

4 cups of flour (about)	1 pound.
2 cups granulated sugar	1 "
$2\frac{2}{3}$ cups powdered sugar	1 "
2 cups butter (packed solidly)	1 "
9 to 10 eggs	1 "
1 square Baker's chocolate	1 ounce.
2 tablespoons butter	1 "
4 tablespoons flour	1 "

Juice of one lemon about 3 tablespoonfuls.

Ways to Combine Ingredients

Ingredients are combined in four ways: viz., by stirring, beating, cutting, and cutting and folding.

Stirring is used to mix ingredients. Stir by beginning in the center and moving the spoon in a circular direction toward the edge. Always stir in the same direction to avoid dispersing any air which may have been incorporated in the mixture.

Beating is a motion which brings the under part of the mixture to the surface over and over again, thus introducing air into the mixture. See "Utensils."

Cutting or Chopping.—This is the method in which the shortening is combined with the flour in making pastry, etc. With two knives worked in opposite directions cut the mixture until it looks mealy and well mixed.

Folding, also called cutting and folding, is the

method used to introduce substances, such as beaten whites of eggs, into a mixture without allowing the air enclosed by the beating to escape. The spoon or knife cuts vertically to the bottom of the dish and the mixture is turned or folded over the top. This process is repeated until the ingredients are well blended.

Proper Utensils to Use

Wooden spoons are generally the best for mixing and stirring. Metal ones ruin enamel and like substances and they are spoiled if used with acids.

A wire-spoon egg-beater and plate should be used when beating whites of eggs as air will be enclosed more quickly if a large surface is exposed to it. A Dover egg-beater or whisk beater are best for beating yolks of eggs and heavy mixtures. A fork is often used for the yolk when it is only slightly beaten, as in custard.

A double boiler should be used for cooking milk and the majority of combinations of milk and eggs over the flame. It is also advisable to use it when cooking substances that burn easily and those which are spoiled by cooking at a high temperature.

See section on measuring for measuring utensils.

Methods of Preserving Food

The decomposition of food is due to the action of certain microörganisms which are always

present in the air. When food is to be kept for any length of time the germs already in it must be killed and the substance kept in sterile, air-tight vessels or else the condition of the food or its surroundings must be made such that the action of the bacteria will be inhibited.

Canning is an example of the first method. The germs are killed by the heat and the food is put into sterile jars or tins and filled to overflowing, thus expelling the air. They are then sealed. Preserving differs from canning in that a larger proportion of sugar is used and this acts as a preservative.

Exclusion of air is sometimes all that is necessary if the food is kept at a low temperature. This may be accomplished in several ways, as:

Coating the food with some impermeable substance, as eggs with paraffin, varnish, etc.

Covering with some substance which will pack tightly and not be propitious for germ development; *e. g.*, packing eggs in salt, etc.

By the use of antiseptic or sterile solutions; *e. g.*, packing eggs in lime solution; cooking and packing fish in oil in sealed tins.

Smoking.—Meats, especially ham and bacon, are often preserved in this manner. Wood smoke contains creosote which permeates the food exposed to it and destroys bacteria.

Examples of the second method of preserving food—rendering either the food or its surroundings unfavorable for germ development—are evapora-

tion, drying, use of antiseptics, and exposure to cold.

Antiseptics.—Alcohol, salt, strong solution of sugar, and vinegar are the legitimate antiseptics used for the preservation of food. Alum, boric acid, borax, formaldehyde, and salicylic acid are also frequently used but investigation has shown that though they may not be really harmful in small quantities they are in large, and that even in small quantities they retard digestion.

Alcohol: Fruits are sometimes preserved in various alcoholic liquors.

Salt: There are two kinds of salting, dry and salting in brine or corning. Meats and fish are the food most commonly preserved in this way.

Sugar Solution: Jellies, jams, and marmalades are examples of the use of sugar as an antiseptic. Sugar aids in preserving certain dried fruits, as raisins and figs.

Vinegar: Pickles are an example of food preserved in vinegar.

Drying and Evaporation.—Germs require a certain amount of moisture for their development and consequently the drier the food the less likely it is to decay. Both animal and vegetable food may be preserved by abstracting their water. According to the amount of water driven off such foods are known as evaporated, dried, or concentrated. The first has the least water driven off and the last the most.

Cold.—Freezing and cold storage are examples

of keeping food at a temperature unfavorable for germ development.

Common Adulterations of Food

The following information regarding common adulterations of food may be of service. It is taken from Bulletin No. 25, of the United States Department of Agriculture, Division of Chemistry.

Articles	Deleterious Adulterations	Fraudulent Adulterations	Accidental Adulterations
Arrow-root.		Other starches which are substituted in whole or in part for the genuine article.	
Brandy.		Water. Burnt sugar.	
Bread.	Sulphate of alum.	Flours other than wheat. Inferior flour. Potatoes.	Ashes from oven. Grit from mill-stones.
Butter.	Copper.	Water. Other fats. Excess of salt. Starch.	Curds.
Canned vegetables.	Salts of copper and lead.	Excess of water.	
Canned meat.	Same.		Meat damaged in process of canning.
Cheese.	Salts of mercury in rind.	Oleomargarine.	
Candy and confectionery.	Poisonous color, artificial essences.	Grape sugar.	Flour.
Coffee.		Chicory. Peas. Rye. Beans. Acorns. Chebus-nuts. Almond or other nutshells. Burnt sugar. Low grade coffees.	
Cocoa and chocolate.	Oxide of iron and other coloring matters.	Animal fats. Starch. Sugar. Flour.	

Articles	Deleterious Adulterations	Fraudulent Adulterations	Accidental Adulterations
Cayenne. pepper.	Red lead.	Ground rice flour. Ship bread. Indian meal.	Oxide of iron.
Flour.	Alum.	Ground rice.	Grit and sand.
Gin.	Alum salt. Spirit of turpentine.	Water. Sugar.	
Honey.		Glucose. Cane sugar.	Pollen of various plants and insects.
Lard.	Caustic lime. Alum.	Starch. Stearin. Salt.	
Milk.		Burnt sugar. Annatto. Water.	Dirt.
Meat.	Infested with parasites.		Tainted.
Horseradish.		Turnip.	
Fruit jellies.	Aniline colors. Artificial essences.	Gelatine. Apple jelly.	
Oatmeal.			Old wormy.
Pickles.	Salts of copper. Alum.		
Preserves.	Aniline colors.	Apples. Pumpkins. Molasses.	
Rum.	Cayenne pepper. Artificial essences.	Water.	Burnt sugar.
Sugar.	Salts of tin and lead.	Rice flour.	
Spices.		Flour. Starches.	
Tea.		Foreign leaves. Spent tea. Plumbago. Gum. Indigo. Prussian blue. China clay. Soapstone. Gypsum.	
Vinegar.	Sulphuric, hydrochloric, and pyroligneous acids.		
Wine.	Aniline colors. Crude brandy.	Water.	Sulphate of potassium.

Serving Food

The proper selection and preparation of food for an invalid is of first importance but the best cooked and most palatable food is often spoiled in the serving. Common errors to be guarded against are, cooking the food long before serving time, putting hot food into cold dishes thus making it lukewarm, putting it untidily into the dishes, or using chipped, unclean, or unsuitable dishes and soiled napery.

In illness even more than in health, dainty serving is imperative as the appetite is poor and unless the tray presents an attractive appearance there will be little inducement to try its contents, in fact, an untidy or overfilled tray will probably inspire a distaste for anything which it holds.

Food should be served at regular intervals. Usually, it is better not to consult the patient regarding his food, but his likes and dislikes should be remembered and complied with if possible. Food should be tasted before it is served but never in the presence of the invalid or with the same spoon he is to use. Hot food should reach the patient hot, and cold food, cold.

Except in the free wards, where unfortunately it is not always possible, the tray should be covered with a clean napkin or tray cover, and the dishes should be the prettiest and daintiest that can be obtained. A flower or sprig of green will often take the person's mind from the food and the

attractiveness of the tray will often tempt one to eat what otherwise would remain untouched.

The quantity of food served will vary with the condition of the person, but in general it is better to serve a small amount and give more if requested. When possible the meal should be served in courses. The dishes on the tray should be placed in the same order as on a table as far as possible, but everything should be placed where the patient can get it without exertion.

Before serving the meal be sure the patient is ready for it. Ready includes having face and hands washed, and a table at hand on which to place the tray. Hospitals are provided with some variety of table which will cross the bed in front of the patient. For home use a rest for the tray may be improvised by placing a block of wood or bundle of magazines on either side of the patient so that the tray will be high enough for him to eat comfortably.

After the patient has finished eating, the tray and all traces of the meal should be removed at once. In contagious diseases everything used should be sterilized by boiling in water for ten minutes.

PART IV

RECIPES

RECIPES

MILK

Albuminized Milk[1]

White 1 egg. — $\frac{1}{16}$ teaspoon salt.
$\frac{1}{2}$ cup cold milk. — 2 tablespoons cracked ice.

Stir white of egg sufficiently to dissolve tenacity, using a silver fork. Add ice, milk, and salt. Beat slightly.

Artificial Buttermilk

2 pints skimmed milk. — $\frac{1}{4}$ cup water.
1 lactone tablet.

Pasteurize the milk. Dissolve the tablet in the water, add this to the milk after it has cooled. Mix thoroughly and let stand, covered, in a warm room for twenty-four hours. Beat with a Dover egg-beater until smooth. Keep in the refrigerator until wanted for use.

Delafield's Mixture

10 grains soda bicarbonate. — $\frac{1}{4}$ cup milk.
5 grains cerium oxalate. — $\frac{1}{4}$ cup cream.
$\frac{1}{4}$ cup Vichy.

Dissolve the soda and cerium oxalate in the milk.

[1] See p. 358 for Eiweiss Milch (Albumin Milk).

Add cream and Vichy. Keep in ice-box. Delafield's mixture is used in cases of extreme nausea and is usually ordered to be given in teaspoon doses.

Junket

1 cup milk.
2 teaspoons sugar.
1 tablespoon sherry.
½ teaspoon Fairchild's essence pepsin or
⅛ of a junket tablet dissolved in 1 teaspoon cold water.
⅛ salt-spoon salt.

Put pepsin or dissolved junket tablet in a bowl. Add sugar, salt, flavouring, heat milk to 100° F. Pour quickly into bowl. Let stand in warm place until firm. Place in ice-box. Serve cold, with or without cream. Brandy, vanilla, or other flavouring extract may be used instead of sherry.

Koumiss

¼ cake Fleischmann's yeast.
1½ tablespoon lukewarm water.
1½ tablespoon sugar.
1 quart milk.

Heat milk to about 70° F., add sugar. Dissolve yeast in water and add to milk. Pour into sterilized bottles,—preferably those with self-adjusting, air-tight stoppers,—fill only to within one and one-half inches of top in order to leave sufficient space for expansion of gas. Cork the bottles, shake well, and place them, inverted, where they can remain at a temperature of 70° F. for ten hours. Shake oc-

casionally to prevent cream clogging mouth of bottle. Place in ice-box, inverted. Shake occasionally. Koumiss will be ready for use in thirty-six hours.

Milk Punch

- 1 teaspoon pulverized sugar.
- 1 tablespoon brandy or whiskey or 2 tablespoons sherry.
- ¾ cup milk.
- 2 tablespoons cracked ice.

Mix spirits and sugar, add milk, shake well in milk shaker or ordinary canning jar. Turn into glass containing cracked ice.

Peptonized Milk (Cold Process)

- 1 tube Fairchild's peptonizing powder or
- 15 grains bicarbonate of soda and 5 grains pancreatin.
- ¼ cup cold water.
- 2 cups fresh milk.

Scald a quart bottle. Put in powder and water. Shake until powder is dissolved. Add milk, shake. Let stand in warm place, 68° F. to 70° F., for ten minutes. Shake well and put in ice-box. The milk must be kept constantly on the ice; otherwise, the digestive process will continue and the milk become bitter.

Peptonized Milk (Warm Process)

Prepare as by cold process, but before putting it into the ice-box let the bottle containing the milk stand in a vessel of hot water, 115° F., for ten minutes

or as directed. Many physicians state the time they wish the peptonizing process to be continued.

When the milk is to be given by rectum the warm process should always be used and the milk should stand for two hours in order that it may be thoroughly peptonized, the large intestine having no power of digestion.

Whey

$\frac{3}{4}$ cup fresh milk
$\frac{1}{2}$ teaspoon rennet or essence of pepsin or
$\frac{1}{8}$ of a junket tablet dissolved in 2 teaspoons cold water.

Put ferment in bowl. Heat milk to 100° F. and add. Stand in warm place until firm. Turn into a strainer covered with two thicknesses of cheese-cloth and set in a cold bowl or pitcher. Cut curd with silver knife and let stand until whey has drained from the curd. Put in ice-box.

When the whey is intended for infant feeding many physicians require that it be heated to 150° F. before putting it in the ice-box. This must be very carefully done as the lactalbumin will coagulate if the above temperature is exceeded.

When intended for adults the whey is frequently flavoured, especially with sherry. Put the sherry into the bowl with the rennet before adding the milk. Sugar may be used if desired.

The nutritive value of whey may be increased by the addition of white of egg. Beat white of egg slightly, using silver fork, add the whey, and pour into a glass containing crushed ice.

Lemon Whey

¾ cup milk. 2 tablespoons lemon juice.

Add lemon juice to milk and let stand five minutes. Strain through double thickness of cheese-cloth.

Wine Whey

½ cup milk. ⅓ cup sherry.

Scald milk and proceed as for Lemon Whey.

Williamson's Diabetic Milk

Cream ½ cup.	Salt ¼ teaspoon.
Water 2 cups.	Saccharine grs. xx.
White 2 eggs.	Water 1 cup.

Combine cream and two cups water. Shake thoroughly and let stand two hours. Skim cream from top. This is called washed cream and is minus sugar. Add the salt, saccharine, and whites of eggs, slightly beaten, to the cream.

EGGS

Eggs hold such an important place in the diet of the sick that every nurse should know a variety of ways to serve them.

Eggs should never be boiled; what are generally known as "boiled eggs" should be cooked in either of the following ways.

Soft Cooked No. 1

Put eggs into sufficient hot water (180° F.) to cover. Place saucepan where water will keep at that temperature for seven or eight minutes.

Soft Cooked No. 2

Put eggs in saucepan of cold water. Heat water very gradually to the boiling point and remove eggs.

Hard Cooked

Cook in same manner as for soft cooked No. 1 and let stand forty-five minutes or as soft cooked No. 2 and let stand thirty minutes. An easy way to regulate the temperature of the water is to use a double boiler and keep the water in the lower part of the boiler just below boiling point.

If eggs are intended for salad, to prevent discolouring of the yolk, chill immediately in cold water.

Dropped or Poached Egg

Have frying-pan three fourths full of boiling water, add one half tablespoon of salt. Butter inside of muffin ring and place in boiling water. Break egg into cup and slip into ring. The water must cover the egg. Cover frying-pan and place where the water will keep hot but not boil. When white of egg is of a jelly-like consistency lift egg and ring with a buttered griddle-cake turner and place on a piece of buttered toast. Remove ring. Garnish with sprig of parsley.

Egg in a Nest

Separate yolk and white of egg. Beat white until stiff and add one eighth teaspoon of salt. Heap on a circular piece of buttered toast. Make a depres-

sion in the centre of white, and drop in yolk. Bake in a moderate oven until white is slightly browned.

Foamy Omelet

1 egg.	$\frac{1}{8}$ teaspoon salt.
1 tablespoon cold water.	$\frac{1}{2}$ teaspoon butter.

Beat egg white until stiff. Beat yolk, add water, and beat until stiff and lemon coloured. Add salt and fold in white. Heat omelet pan and butter sides and bottom. Turn in mixture and cook until a delicate brown underneath. Place in oven until top is dry and firm to the touch. Fold and turn on to a hot platter, garnish, and serve immediately.

Bread Omelet

1 egg.	2 tablespoons milk.
2 tablespoons stale bread-crumbs.	$\frac{1}{4}$ teaspoon salt.
	$\frac{1}{2}$ teaspoon butter.

Soak bread-crumbs in milk. When soft add to well beaten yolk and continue as in Foamy Omelet.

For variation, just before folding, the omelet may be spread with finely chopped meat, creamed fish, grated cheese, jelly, or sliced fruit.

A tomato or cream sauce is often served with an omelet.

Scrambled Eggs

1 egg.	$\frac{1}{2}$ tablespoon butter.
4 tablespoons milk.	$\frac{1}{16}$ teaspoon salt.

Beat egg slightly, add milk and salt. Heat omelet pan, put in butter and when melted add egg mixture. Cook slowly until of a creamy consistency,

continuously stirring and scraping from bottom and sides of pan. Serve on toast.

Shirred Egg

1 egg.
Few grains salt.
2 tablespoons soft bread-crumbs.
1 teaspoon melted butter.

Melt butter and mix with bread-crumbs. Cover bottom of egg shirrer with one tablespoon of the crumbs, break egg and slip into shirrer, sprinkle with the salt, and cover with remaining crumbs. Bake in a moderate oven until white is set.

Hamburg Cream (Lemon)

1 egg.
1 tablespoon sugar.
$\frac{1}{16}$ teaspoon salt.
$1\frac{1}{2}$ tablespoon lemon juice.

Separate the white from the yolk of the egg, beat it until stiff. Beat the yolk slightly, add sugar, salt, and lemon juice. Cook in a double boiler until mixture thickens, stirring it constantly. Fold in white of egg. Heap lightly in glass. Chill.

Orange Cream

1 egg.
$\frac{3}{4}$ tablespoon sugar.
$2\frac{1}{2}$ tablespoons orange juice.
1 teaspoon lemon juice.
$\frac{1}{16}$ teaspoon salt.

Make in same manner as Lemon Cream.

Wine Cream

1 egg.
$\frac{3}{4}$ tablespoon sugar.
2 tablespoons sherry or Madeira wine.
$\frac{1}{16}$ teaspoon salt.

Make in same manner as Lemon Cream.

CUSTARDS

Steamed Custard

1 egg or the yolks of two eggs.
¾ cup scalded milk.
1 tablespoon sugar.
⅛ teaspoon salt.
¼ teaspoon vanilla or other flavouring extract.

Beat egg slightly, add salt, sugar, and gradually the hot milk. Cook in double boiler until the mixture thickens sufficiently to coat spoon. Stir constantly during cooking. Strain, add flavouring, and chill.

If custard is cooked too long or too quickly it will curdle. Should this happen, turn immediately into cold bowl and beat with Dover egg-beater.

Steamed Caramel Custard

Cook sugar, two tablespoons, stirring constantly until of the colour and consistency of maple syrup. Mix this with the milk before adding to the egg. Cook in same manner as Steamed Custard.

Steamed Coffee Custard

Make in same manner as first recipe with exception of scalding one tablespoon of ground coffee in the milk and straining before adding to the egg.

Steamed Chocolate Custard

Make same as first recipe with the addition of the chocolate. Melt one half square of Baker's chocolate

and add two tablespoons of milk. Cook over hot water until smooth and then add to remaining milk.

Baked Custard

Use same ingredients as for steamed custard adding one half tablespoon more of sugar. Combine in same manner but instead of cooking mixture in double boiler turn into buttered custard cups, set in pan of warm water, and bake in a slow oven until custard is firm. To test if custard is done, insert and remove a warmed knife. It it returns clear, cooking is completed.

Steamed and baked custards are often ornamented with meringue.

Meringue

1 egg white.
$\frac{1}{16}$ teaspoon salt.
$1\frac{1}{2}$ tablespoon powdered sugar.
Lemon or orange juice or other flavouring.

Beat egg until stiff and dry, add salt, sugar, and flavouring. Beat sufficiently to blend. Heap on custard. Brown slightly in oven.

Egg Soufflé

$\frac{1}{2}$ tablespoon butter.
$\frac{1}{2}$ tablespoon flour.
$\frac{1}{2}$ cup cream, scalded.
1 egg.
$\frac{1}{8}$ teaspoon salt.

Cream the butter, stir in the flour, when well blended add hot cream slowly, stirring constantly. Cook in double boiler three minutes. Cool slightly and add yolk of egg well beaten. Add salt. Fold in white of egg beaten until stiff and dry. Turn into buttered pudding dish. Place in pan of hot water, and bake in a slow oven until firm.

EGG DRINKS

Egg Albumin

1 egg white.	$\frac{1}{16}$ teaspoon salt.
2 teaspoons sugar.	$\frac{2}{3}$ cup warm water.
2 tablespoons lemon juice.	Crushed ice.

Dissolve sugar in warm water. Add ice and lemon juice. Beat white just enough to break up the walls of the cells of albumin which make the white tenacious. Add lemon syrup to white, and then salt. Shake or beat mixture. Strain.

Three tablespoons of orange juice or two tablespoons of sherry may be substituted for the lemon juice if desired.

Egg Albumin with Whey

1 egg white.	2 tablespoons sherry.
$\frac{1}{2}$ cup rennet whey (page 170)	2 teaspoons sugar.
Cracked ice.	$\frac{1}{8}$ teaspoon salt.

Beat white of egg slightly, add whey, sherry, sugar, and salt.

Egg Lemonade

1 egg.	1 tablespoon sherry.
$\frac{1}{2}$ cup warm water.	1 tablespoon sugar.
2 tablespoons lemon juice.	Crushed ice.

Beat egg well, using Dover egg-beater. Dissolve sugar and salt in water. Add ice, lemon, and wine. Strain. Pour into glasses one third full of crushed ice.

Egg-Nog

1 egg.
$\frac{2}{3}$ cup milk.
$\frac{1}{8}$ teaspoon salt.
2 teaspoons sugar.
$1\frac{1}{2}$ tablespoon sherry or
1 tablespoon brandy or rum.
Crushed ice.

Beat white of egg until fairly stiff but not dry. Beat yolk with Dover egg-beater, add sugar, salt, and, very slowly, the liquor; beat well. Add milk and white of egg and turn into glass. Nutmeg may be grated over the top.

One fourth cup of strong coffee may be substituted for liquor and a little less milk used.

Orange Egg

1 egg.
$\frac{1}{2}$ cup orange juice.
2 tablespoons crushed ice.
2 teaspoons powdered sugar.

Beat egg well, using Dover egg-beater. Add sugar, crushed ice, and orange juice.

In making cold drinks it is always better to use either powdered sugar or sugar syrup than granulated sugar. If put into a sterile bottle and kept in a cold place, sugar syrup will keep for some time and there should be a supply on hand in every diet kitchen.

Sugar Syrup

$\frac{3}{4}$ cup sugar.
$\frac{3}{4}$ cup boiling water.

Add sugar to water and stir until sugar is dissolved. Boil slowly, without stirring, for twenty minutes.

Egg in Coffee, etc.

Eggs are frequently given patients in coffee, cocoa, purée, etc. To prepare, cool the liquid to a temperature of 190° F. Beat the egg slightly and add. Reheat if necessary but not above 190° F. Serve immediately.

The recipes in this section, with the exception of bread omelet, caramel custard, chocolate custard, and egg soufflé, can be used in cooking for diabetic patients if the sweetening is done with saccharine.

Saccharine is a coal-tar product which is between two and three hundred times sweeter than sugar. It is usually purchased in the form of tablets. The tablets are generally dissolved in lukewarm water (2 teaspoons of water to a 1 grain tablet) before being added to the food. Saccharine should not be added until cooking is nearly completed or a bitter taste will be developed.

CEREALS. GRUELS. CEREAL JELLIES. CEREAL PUDDINGS

The digestibility of cereals depends largely upon the thoroughness of the cooking. For children and invalids especially they should be cooked for several hours in order to soften the cellulose and make the starch more soluble. The cooking is facilitated if the cereal is boiled directly over the fire for the first five or ten minutes and then put over the lower part of the double boiler and cooked for the remainder of the time.

The majority of coarse cereals are slowly scattered

into the boiling salted water, allowing one teaspoon of salt for each cup of cereal. The flour or fine cereals are best made into a paste with cold water before adding to the boiling water as this prevents lumping.

The following table gives the proportion of cereal to water and the time required for cooking the more common ones.

	Cereal	Water	Time of Cooking
Cream of Wheat	3 1/5 tablespoons	1 cup	45 to 60 minutes.
Hominy (fine)	3 1/3 "	1 "	1 to 1 1/2 hours.
Indian Meal	3 1/3 "	1 "	3 hours.
Oatmeal (coarse)	3 "	7/8 "	3 hours, at least.
Pettijohn	1/2 cup	1 "	30 to 45 minutes.
Rolled Oats	1/3 "	7/8 "	1 hour.
Rice	1/4 "	1 " Old rice more	45 to 60 minutes.
Wheatena	3 1/2 tablespoons	1 cup	45 " 60 "

To give variety and flavour raisins are sometimes added to the water in which the cereal is to be cooked. Dates, with seeds removed, may be added just before cereal is taken from the fire. Stewed prunes, figs, or fresh fruit may be served with the cereal.

GRUELS

Gruels are made from flour or grains, using either water or milk, or milk and water. Those which require cooking for any length of time should not be made of all milk and that used should be added when gruel is thoroughly cooked as the high temperature necessary to cook the cereal properly affects the digestibility of milk. Few patients like sweetened or highly flavoured gruels. Salt, wine, and nutmeg are the seasonings most frequently used.

Oatmeal and Indian meal contain more nourish-

ment than the majority of gruels. They are much used when there is a tendency to constipation, while arrowroot, barley, and flour gruels are frequently used in cases of diarrhœa and dysentery.

Arrowroot Gruel

1½ teaspoons Bermuda arrowroot.
1 tablespoon cold water.
½ cup boiling water.
½ cup hot milk.
⅛ teaspoon salt.
1 teaspoon sugar, if desired.

Blend arrowroot with cold water and add to boiling water. Boil ten minutes. Add milk and cook in top of double boiler ten or fifteen minutes.

If more nutriment is desired, just before removing from fire add beaten yolk of egg and after removing from stove fold in white, beaten stiff.

Barley Gruel

1 tablespoon Robinson's prepared barley.
2 tablespoons cold water.
1 cup boiling water.
½ cup warm milk.
⅛ teaspoon salt.

Blend flour with cold water, add slowly to boiling water, stirring constantly. Boil twenty minutes. Add milk and salt, bring to boiling point, and strain.

Cracker Gruel

1½ tablespoon sifted cracker crumbs.
¾ cup milk.
⅛ teaspoon salt.

Scald milk. Add cracker crumbs and cook in double boiler five minutes. Add salt.

Indian Meal Gruel

1 tablespoon granulated Indian meal.
½ tablespoon flour.
3 tablespoons cold water.
¼ teaspoon salt.
1½ cup boiling water.
½ cup warm milk.

Mix meal, flour, and salt with cold water, and add hot water gradually, stirring constantly. Boil one and one half hours. Add milk and reheat to boiling point. Serve with cream if desired.

Flour Gruel

½ tablespoon flour.
⅛ teaspoon salt.
1 tablespoon cold milk.
1 cup hot milk.

Mix flour and salt and blend with cold milk. Add to hot milk and cook half an hour in double boiler.

Oatmeal Gruel

¼ cup rolled oats.
¼ teaspoon salt.
1½ cup boiling water.
½ cup hot milk.

Add oats to boiling salted water and boil five or ten minutes over fire and then cook in double boiler two hours. Add milk and reheat.

Rice Gruel No. 1

1 tablespoon rice.
1 cup milk.
⅛ teaspoon salt.

Pick over and wash rice. Cover with cold water and let stand two hours. Strain, add milk to rice, and cook in a double boiler one and one half hours. Strain and add salt.

Rice Gruel No. 2

¼ tablespoon rice flour.
1 tablespoon cold water.
1½ cup boiling water.
½ cup hot milk.
¼ teaspoon salt.

Blend flour and cold water, add boiling water, and cook in a double boiler one hour. Add salt and milk. Reheat and strain.

Caudle

½ cup oatmeal or barley gruel.
1 egg.
2 tablespoons sherry wine.
1 teaspoon sugar.

Beat egg thoroughly, add sugar and wine, and stir into gruel. Reheat and grate nutmeg over the top.

JELLIES MADE FROM CEREALS

Barley Jelly

1 tablespoon barley flour.
1 tablespoon cold water.
1 cup hot water.
¼ teaspoon salt.
2 tablespoons lemon juice or wine.

Blend flour and cold water, add hot water, and boil thirty minutes. Strain, add salt and flavouring. Mould. Chill.

Oatmeal Jelly

3 tablespoons rolled oats.
1 pint boiling water.
¼ teaspoon salt.
2 tablespoons lemon juice or wine.

Add oats to boiling salted water and boil three hours. The grain should be thoroughly cooked and the gruel thick enough so it can just be poured. Strain through several thicknesses of gauze. Add flavouring. Mould and chill.

DRINKS MADE FROM CEREALS

Barley Water

1 tablespoon barley flour.
2 tablespoons cold water.
2 cups boiling water.
$\frac{1}{4}$ teaspoon salt.
2 tablespoons lemon juice, or sherry wine if desired.
2 teaspoons sugar, if desired.

Blend flour and cold water and add slowly to boiling water, stirring constantly. Boil thirty minutes, add salt and flavouring. Strain. Salt and flavouring are omitted when barley water is prepared for infants.

Rice Water

1 tablespoon rice.
$1\frac{1}{2}$ cup cold water.
$\frac{1}{4}$ teaspoon salt.

Wash rice, add cold water, and let stand thirty minutes. Boil in the same water until rice is very soft—about thirty minutes. Add salt and strain. Cream or milk may be added if desired.

Toast Water

2 slices stale bread.
1 cup boiling water.
$\frac{1}{8}$ teaspoon salt.

Toast bread in a slow oven until thoroughly dried

and browned. Break into small pieces, add water, and let soak one hour. Add salt and strain. May be served hot or cold.

PUDDINGS MADE WITH CEREALS

Corn-Starch Pudding

$1\frac{1}{2}$ tablespoon corn-starch.
$1\frac{1}{2}$ teaspoon sugar.
$\frac{1}{8}$ teaspoon salt.
2 tablespoons cold milk.
$\frac{2}{3}$ cup scalded milk.
1 egg.
$\frac{1}{4}$ teaspoon vanilla.

Mix starch, sugar, salt, and cold milk. Add gradually to scalded milk, stirring constantly. Cook in double boiler ten minutes. Remove from fire and add yolk of egg well beaten. Cook two minutes. Add flavouring. Let stand until slightly cooled and fold in white of egg beaten until stiff. Mould and chill. Serve with cream or custard.

Chocolate Corn-Starch Pudding

Melt one third square unsweetened chocolate as directed on page 244 and add it to the scalded milk.

Orange Corn-Starch Pudding

Use orange or almond extract instead of vanilla and line mould with sections of seedless orange before pouring in mixture.

Rice Pudding

$\frac{1}{4}$ cup steamed rice.
$\frac{1}{4}$ cup scalded milk.
1 teaspoon butter.
$\frac{1}{2}$ an egg.
2 teaspoons sugar.
$\frac{1}{16}$ teaspoon salt.
Stoned raisins.
$\frac{1}{4}$ teaspoon vanilla.

Beat egg slightly and add scalded milk, sugar, and butter. Add to rice. Add raisins and vanilla. Turn into buttered pudding dish. Bake in a moderate oven until custard is firm.

To Steam Rice

1 cup boiling water. $\frac{1}{3}$ cup rice.
$\frac{1}{8}$ teaspoon salt.

Wash and pick over rice. Scatter slowly into boiling salted water and boil ten minutes, then cook one hour or until tender in double boiler. Do not stir while cooking.

Cream of Rice Pudding

1 tablespoon rice. $\frac{1}{8}$ teaspoon salt.
1 tablespoon sugar. $\frac{1}{2}$ cup milk.

Wash and pick over rice. Mix all ingredients and turn into buttered pudding dish. Bake one and one half hours in slow oven. During the first part of baking, cut crust several times, stirring it to the bottom.

Tapioca Cream

1 tablespoon granulated tapioca.
1 tablespoon sugar.
$\frac{1}{8}$ teaspoon salt.
$\frac{3}{4}$ cup scalded milk.
1 egg.
$\frac{1}{4}$ teaspoon vanilla or other flavouring.

Mix dry ingredients and add milk slowly. Cook fifteen minutes. Add egg well beaten. Cook two minutes over hot water. Add flavouring. Any fruit or fruit juice can be used as flavouring.

SOUPS. BROTHS. MEAT JELLIES MADE WITHOUT GELATINE

Soup Stock

As has been previously stated the tougher portions of meat are used for this purpose. Beef is generally considered to make the best flavoured stock and a small amount of veal is a help in giving the stock a jelly-like consistency. Bone is also included for the same reason as well as for its mineral matter. Mutton and lamb should not be used in any quantity and their fats should never be used on account of their strong flavour. Pork and all kinds of corned and smoked meats are also, as a rule, undesirable.

To Make the Stock.—For a good stock allow one pint of water for every pound of meat. The meat should consist of three parts lean meat to one of bone, gristle, and fat. Meat which has already been cooked, if browned in a frying-pan which has been greased with marrow from the bones, will add to the flavour and colour of the soup. Vegetables, herbs, and spices may be used if desired.

Cut the meat in small pieces, cover with cold water, and let stand for about an hour. Heat very gradually to the simmering point and simmer for six hours. Add vegetables, spices, etc., and cook one hour longer. During the cooking the scum which rises may be removed if a clear soup is required. This scum holds the coagulated protein and its removal diminishes the nutritive value of the soup. When cooked, strain the stock and cool it as quickly as possible. When cold the fat forms a crust on the top of the

stock; this should not be removed until the stock is to be used as it excludes the air and with it the micro-organisms likely to produce putrefaction.

The stock may be used as the basis for a variety of soups. It may be cleared or thickened and vegetables, rice, macaroni, barley, etc., may be added.

To Clear Stock

For every quart of stock allow the white and shell of one egg.

Remove the fat from the stock and if extra seasoning is needed add before clearing. Beat white of egg slightly, crush shell, and add them to the stock. Bring stock to the boiling point, stirring constantly. Boil two minutes and then place where it will simmer for ten or fifteen minutes. Remove scum, and drain liquid through a double cheese-cloth.

To Colour Soups

Many colouring fluids may be bought but the following one is inexpensive and easily made.

Equal parts sugar and boiling water.

Melt and brown sugar in frying-pan. Add the water and boil until sugar is dissolved. Strain and pour into a sterile bottle. This will keep for a long time. If the sugar has been well browned it will take about two tablespoons of the liquid to colour a quart of soup. If too much is used the soup will be bitter.

To Thicken or Bind Soups

(For a Thin Soup)

$\frac{3}{4}$ cup liquid.
1 teaspoon flour.
1 teaspoon butter.
Pepper and other seasonings.
$\frac{1}{8}$ teaspoon salt.

Place butter and flour in a saucepan; as the butter melts stir in the flour. When well mixed add hot liquid slowly and cook until it thickens. If milk is used it is better to cook in double boiler. If a large quantity is made add only a part of the liquid to the flour mixture at first and stir until smooth, and then add remainder.

Cream soups and purées are made in this way, milk and some vegetable juice or sifted pulp being used instead of stock.

Clam Soup

6 clams.
$\frac{1}{4}$ cup cold water.
1 cup hot milk.
1 teaspoon flour.
1 teaspoon butter.
$\frac{1}{8}$ teaspoon salt.
Pepper.

Scrub clams, put in saucepan with cold water, and cook until shells open. Remove clams from shell, being careful not to lose the juice. Cut out and discard the tough part of clams. Blend flour and butter as in last recipe, add hot clam juice, milk, and seasonings. Cook five minutes, stirring constantly. Add clams.

Oyster Soup

½ cup oysters, juice and oysters.
¼ cup hot milk.
1 teaspoon flour.
1 teaspoon butter.
⅛ teaspoon salt.
Pepper and celery salt if desired.

Blend flour and butter in usual manner. Heat oyster juice and add the mixture. Add hot milk and seasonings. Cook five minutes in double boiler, stirring constantly. Add oysters, and cook, below boiling point, until they become plump and their edges curl. Serve immediately.

Cream of Pea Soup

⅓ cup canned peas.
¼ cup cold water.
1 teaspoon butter.
1½ teaspoon flour.
⅔ cup scalded milk.
⅛ teaspoon salt.
Few grains pepper.

Drain peas from their liquor, add cold water, heat slowiy, and boil ten minutes. Rub through a sieve. Blend butter and flour, add hot milk, and cook as in other recipes. Add seasonings and pea mixture. Reheat.

Potato Soup

1 teaspoon flour.
1 teaspoon butter.
2 tablespoons hot mashed potato.
¾ cup hot milk.
⅛ teaspoon salt.
Thin slice onion.
Pepper and celery salt if desired.

Scald onion with milk and then remove it. Blend flour and butter, add milk, and cook as in other

recipes, mix with potato, add seasonings, and reheat. Stir thoroughly.

Cream of Tomato Soup

$\frac{1}{2}$ cup stewed or canned tomato.
Few slices onion, if desired.
Sprig of thyme or bay leaf.
$\frac{1}{16}$ teaspoon soda.
$1\frac{1}{2}$ teaspoon flour.
1 teaspoon butter.
$\frac{1}{4}$ cup milk.
$\frac{1}{4}$ teaspoon sugar.
$\frac{1}{4}$ teaspoon salt.
Pepper.

Heat tomatoes with onion and bay leaf. Add soda after taking from heat. Strain. Add to butter and flour blended in usual manner and cook five minutes. Add hot milk and remaining seasoning and serve immediately.

Fruit Soup

$\frac{1}{4}$ cup dried apricots.
$\frac{1}{4}$ cup dried prunes.
1 cup cold water.
1 teaspoon sugar.
1 teaspoon flour.

Pick over and wash fruit. Add cold water. Let stand one hour, then cook until the fruit is soft. Mix flour, salt, and sugar. Add the hot liquid very slowly, stirring constantly. Cook ten minutes.

BEEF TEA, BEEF JUICE, BROTH

Beef Tea

1 lb. beef (round).
1 pint cold water.
$\frac{1}{2}$ teaspoon salt.

Remove fat and wipe meat with damp towel. Cut in small pieces and put in a canning jar. Add cold water and let stand half an hour. Place jar on a trivet in a kettle which contains sufficient cold water to surround that in the jar. Heat the water very gradually to 140° F. Keep it at that temperature for two hours. Then slowly increase the heat sufficiently to turn the tea a deep chocolate colour. Add the salt, and pepper if desired. Never allow beef tea to boil either when making or reheating it.

Beef Juice No. 1

Proceed as when making beef tea with two exceptions: add no water to the beef, and when the water surrounding the jar has been 130° F. for two hours turn the meat, a little at a time, into a *hot* meat press or lemon squeezer and express the juice. When juice is cold remove fat which rises to the top. To reheat place cup containing juice in a saucepan of hot water. Do not allow the juice to exceed a temperature of 105° F., as it coagulates very readily. Season with salt and pepper and, if desired, flavour with wine.

Beef Juice No. 2

Remove fat and wipe meat with a damp cloth. Broil for four minutes, turning steak every ten seconds for the first minute and afterwards every thirty seconds. Place meat on a hot platter, cut in small pieces, and make several gashes on both sides of each piece. Proceed as for Beef Juice No. 1.

Chicken Broth

3½ lb. chicken.
3 pints water.
½ teaspoon salt.
Few grains pepper.
2 tablespoons rice.

Dress and clean chicken. Remove skin and feet. Add water and let stand half an hour. Heat slowly to simmering point and cook until meat is tender—about three hours. Skim during cooking. When half cooked add rice and seasonings. Strain. Cool and remove fat before reheating.

Lamb Broth

1 lb. lamb.
1 pint cold water.
1 tablespoon boiled rice.
¼ teaspoon salt.

Wipe meat. Remove fat. Cut meat in small pieces, add cold water to meat and bone, and let stand half an hour. Heat slowly to simmering point, and cook until meat is tender—about three hours. Skim during cooking. When half cooked add salt.

When cooked strain, cool, and remove the fat before reheating. Add boiled rice, a teaspoon of chopped parsley, and pepper, if desired, just before serving.

MEAT JELLIES MADE WITHOUT GELATINE

Calf's Foot Jelly

1 calf's foot.
3½ pints cold water.
½ cup sherry wine.
3 tablespoons lemon juice.
½ cup sugar.
3 egg whites and shells.

Put calf's foot into three pints of water, bringing

slowly to the boiling point and boil five hours. Skim frequently while cooking. Strain and stand in a cold place until firm. Remove fat. Mix one cup cold water, the whites and shells of eggs, wine and sugar. Beat well and add to jelly. Heat but do not allow to boil, stirring constantly. Strain several times through double thickness of cheese-cloth placed in fine strainer. Pour into moulds. Chill until jellied.

Chicken Broth Jelly

3 lb. chicken.	1 teaspoon salt.
1 quart water.	Pepper.

Prepare chicken as for chicken broth, cut in small pieces, and cover with cold water. Let stand half an hour. Cook slowly until meat is very soft and water reduced to one pint. Skim frequently while cooking. Season. Strain. Mould, and keep in ice-box until jellied.

FISH

Fish must be thoroughly cooked but not at too high a temperature. The muscle of the fish has large fibres and little connective tissue so it breaks easily unless care is taken to prevent it. Salt is added to the water in which fish is cooked to improve the flavour and either lemon juice or vinegar to help whiten the flesh.

Fish may be boiled, broiled, baked, fried, or steamed. Boiling is the most wasteful method unless the water is to be used for stock. White fish if cooked in water needs to be supplemented by a rich sauce and when baked should be basted often with fat.

Fish suitable for baking whole are cod, haddock, cusk, bluefish, small salmon, bass, shad, whitefish, and mackerel.

Those used for boiling are salmon, cod, halibut, haddock, and bluefish.

Those used for broiling: Split—Mackerel, shad, young cod, bluefish, whitefish, trout. Sliced—Chicken halibut and salmon. Whole—Smelts, perch, and other small fish.

To Clean Fish

Make a lengthwise incision along the under side of the fish and remove entrails. To remove scales hold fish by the tail and scrape body with a knife, beginning at the tail and working toward the head. Keep the upper edge of the knife bent forward to prevent the scales flying. Wipe fish inside and out with cloth wrung out of cold water. Dry.

To Bake Fish

Clean and stuff if desired. Place on a greased fish sheet, in a dripping-pan. A strip of thick cotton cloth may be substituted for the fish sheet. Sprinkle with salt and pepper, brush over with melted butter, and dredge with flour. White fish, especially, are frequently larded (see page 308). Cover bottom of pan with water or vegetable stock. Baste during cooking with one fourth cup melted butter.

Remove to hot platter and garnish with lemon and parsley.

Time Required for Baking

Thick fish—weight 3 or 4 lbs.	45 to 60 minutes.
Small fish	20 to 30 minutes.

When cooked the flesh separates easily from the bone.

Stuffing for Baked Fish

¼ cup cracker crumbs.
¼ cup stale bread crumbs.
½ tablespoon melted butter.
⅛ teaspoon salt.
Few grains pepper.
Few drops onion juice.
1 teaspoon chopped parsley.
1 teaspoon capers or pickles.

Mix ingredients. Stuff fish and sew together to prevent escape of stuffing.

To Boil Fish

Small fish are boiled whole, and large ones cut in a thick slice of the desired number of pounds. Clean fish and place on fish rack or if fish is not too large in a frying-basket. Submerge in boiling water containing a teaspoon of salt for every quart of water and an equal quantity of lemon juice or vinegar. Sliced fish should be tied in cheese-cloth to prevent scum depositing on it.

Time Required for Boiling

Bluefish and bass	4 to 5 lbs.	40 to 45 minutes.
Cod and haddock	3 " 5 "	20 " 30 "
Halibut—thick	2 " 3 "	20 " 30 "
Salmon	2 " 3 "	30 " 35 "

To Broil Fish

Small fish are broiled whole and larger ones either cut in inch-thick slices or slit down the back, flattened, and broiled whole.

Clean fish. Put in hot well greased double broiler with thickest part of fish in centre of broiler. Brush white fish with melted butter. When broiling turn slices of fish frequently; but cook split fish first on flesh side and then on skin side. When cooked loosen fish from both sides of broiler before attempting to open it. Slip fish on to platter, flesh side up. Season with butter, pepper, and salt. Garnish with parsley and slices of lemon.

Time Required to Broil

Slices of bluefish, shad, and whitefish	15 to 20 minutes.
Slices of halibut and salmon	12 " 15 "
Small thin fish.	5 " 10 "

To Fry Fish

Clean and dry fish. Sprinkle with salt, dip in flour, cracker, or stale bread crumbs, then in egg slightly beaten, and again in flour or crumbs. Fry in deep fat.

To Sauté Fish

Prepare as for frying but cook in frying-pan with small amount of fat.

Time Required to Fry and Sauté

Fish steaks	4 to 6 minutes.
Small fish	3 " 5 "

OYSTERS

Broiled Oysters

4 large oysters. $1\frac{1}{2}$ tablespoon melted butter.
$\frac{1}{4}$ cup cracker crumbs. Salt and pepper.

Drain oysters from liquor, dry with soft towel. Mix crumbs, salt, and pepper. Take up each oyster separately by putting a silver fork through the tough muscle and dip it first in the butter and then in the cracker crumbs. Place oysters in a small, hot, buttered broiler and broil two minutes. Turn broiler every few seconds. Serve on slice of toast. Garnish with parsley and lemon.

Creamed Oysters

1 teaspoon butter. $\frac{1}{4}$ cup oysters.
1 teaspoon flour. $\frac{1}{3}$ cup scalded milk.
$\frac{1}{16}$ teaspoon salt.

Mix salt and flour, stir into melted butter. Add hot milk and cook five minutes in double boiler. Look over oysters to be sure there are no shells and cook in their own liquor until plump. The liquor must not be allowed to boil. Add to sauce. Serve on toast or in croustades of bread.

SAUCES TO SERVE WITH FISH

Hollandaise Sauce

$\frac{1}{4}$ cup butter. 3 tablespoons boiling water.
1 egg yolk. $\frac{1}{8}$ teaspoon salt.
$\frac{1}{2}$ tablespoon lemon juice. Few grains cayenne.

Wash butter. Divide in three pieces and put one

piece in double boiler with yolk of egg slightly beaten and lemon juice. Cook over hot water, stirring constantly until butter is melted. Add second piece of butter and as the mixture thickens the third piece. Add water, salt, and cayenne and cook one minute. Sauce will curdle if cooked too long.

Maître d'Hôtel Butter

2 tablespoons butter.
$\frac{1}{4}$ teaspoon salt.
$\frac{1}{16}$ teaspoon pepper.
1 teaspoon chopped parsley.
2 teaspoons lemon juice.

Work butter until creamy, using a wooden spoon. Add salt, pepper, and parsley and then, very slowly, the lemon juice.

White Sauce

1 teaspoon butter.
1 teaspoon flour.
$\frac{1}{3}$ cup scalded milk.
Few grains pepper.
$\frac{1}{16}$ teaspoon salt.

Mix flour and salt and stir into melted butter. When well mixed add the scalded milk. Cook five minutes in a double boiler. Add pepper.

Capers or chopped pickles, parsley or hard-cooked egg are often added to white sauce when served with fish.

POULTRY

To Clean.—Cut off the head. Pull out pin-feathers, using vegetable knife. If the bird has not been drawn make an incision below the breast-bone just large enough to admit hand or with small birds the finger. Put in the hand or finger and with firm

traction remove all the entrails together, taking care not to rupture them, especially the gall-bladder. Turn down the skin of the neck and pull out windpipe and crop. Cut off neck close to the body. Cut through the skin of the leg a little below the joint, taking care not to cut the tendons. Then place the leg with the cut on the edge of the table, press downward until leg bone snaps, hold bird firmly and pull off foot and, if the bird is not too old, the tendons will be drawn out with it. In old birds it is better to pull out the tendons separately with a skewer. Cut out the oil bag. Singe the bird by holding it over a flame, turning until all parts of the body have been exposed to the heat. Wash the bird by allowing cold water to run through and over it. Dry well inside and out. Stuff if desired and truss.

Stuffing (Wet)

1 cup cracker crumbs
⅓ cup melted butter.
⅛ teaspoon pepper.
¼ teaspoon salt.
Powdered sage, summer savory, and marjoram.
⅓ cup boiling water, hot milk, or milk and egg.

Mix seasonings and cracker crumbs. Add butter to liquid and then add to cracker crumbs.

Stuffing (Dry)

1 cup stale bread crumbs.
¼ cup butter—not melted.
Seasonings as for wet dressing.

Mix all ingredients thoroughly.

Put stuffing in both openings in the body but allow

for swelling, especially when using cracker crumbs, otherwise the skin will burst.

To Truss.—After stuffing the bird sew the skin at both ends turning that at the neck under the back. Secure the wings in place with a skewer. Draw the thighs close to the body and secure them in place by passing the skewer through them and the body. Fasten the drumsticks of ducks and other birds with short legs in place against the body with twine. With long legged fowl, cross the drumsticks and tie them with a long piece of twine, then bring the string around the body of the fowl and cross its ends under the back. Twist the end of the string on each side around the corresponding ends of the skewers holding the wings and thighs in place.

Cut string and remove skewers before serving the bird.

To Roast Poultry

Combine two tablespoons of flour with three tablespoons of butter and stir until creamy. Rub surface of bird with salt and spread with the butter and flour mixture. Place bird on its breast on dripping-pan rack and place in a hot oven. In eight minutes the heat of the oven should be reduced. Baste fowl every ten minutes. For basting use ¼ cup butter melted in ⅔ cup hot water. Turn bird on its back when half the time required for roasting is over.

Time Required for Roasting

Chicken	3 to 4 lbs.	1 to 1½ hours.
Duck (domestic)		1 " 1½ "

Duck (wild)		20 to 30 minutes.
Goose	9 lbs.	2 hours.
Turkey	9 lbs.	2½ to 3 hours.
Partridge		45 to 50 minutes.
Squab		25 " 35 "

To Make Gravy

Clean giblets, *i.e.*, the heart, liver, and gizzard. Remove membrane, blood-vessels, and clotted blood from the heart. Cut gall-bladder from liver together with any part of the latter which has a greenish tinge. Remove fat and membrane from around gizzard and remove sac. This is done by cutting through the thickest part of gizzard to the sac, taking care not to pierce it. Wash giblets and neck and put on to cook in two cups of cold water; bring slowly to the simmering point and simmer until tender.

After chicken is roasted remove to hot platter, pour off the fat, strain, and return three tablespoons to pan. Add slowly three tablespoons of flour, brown well, and then add one and one half cups of the water in which the giblets were cooked. Cook five minutes, stirring continuously. Add pepper, salt, and if desired the giblets, which have been minced.

To Boil Poultry

Clean and truss as for roasting but do not stuff. Tie in a piece of cheese-cloth. Place on a trivet in a kettle of boiling water. Cover and cook slowly until tender, turning occasionally.

Time Required for Boiling

Chicken	3 lbs.	1 to 1¼ hours.
Fowl	4 to 5 lbs.	2 " 3 "
Turkey	9 lbs.	2 " 3 "

To Broil Poultry

To Dress for Broiling.—Cut off head. Take out pin-feathers. Singe and wipe. Make a cut through the backbone the entire length of the bird. Lay open and remove entrails. Cut out breast-bone and ribs. Remove feet in the same way as for roasting. Wash with wet cloth.

Sprinkle with salt and pepper and place in a hot well greased broiler. Expose flesh side to heat first and have it so the greater part of the time, as the skin burns easily.

Time Required for Broiling

Chicken	20 minutes.
Small birds	8 to 12 minutes.

MEATS

The important points to remember in cooking meat are the effects of heat, salt, and water on its protein substances.

If meat is allowed to stand in cold or warm water a large amount of its juices and extractives will be dissolved, therefore when cleaning meat wipe it with a damp cloth but never put it in water.

When desirous of drawing out the juices, as when

making broths and soups, let the meat stand in cold or warm water for some time before cooking.

Heat coagulates those proteins at the surface of the meat thus forming a crust to prevent the escape of the juices, therefore when they are to be retained in the meat, as in broiled, boiled, or roasted meats, it must be subjected for a time to intense heat, but this high temperature must not be maintained for any length of time or the protein will become hardened and the meat thus made tough. Roasts are as quickly, and much more uniformly, cooked at 175° C. as at 200° C.

Tough meat can often be improved by pounding, to break the fibers, and covering with lemon juice or diluted vinegar.

To Roast Meat

Wipe, put on rack in dripping-pan, rub surface with salt, dredge both meat and pan with flour, and unless meat is very fat put trimmings of fat or drippings around it. Place in a hot oven. After the surface of the meat is seared, which will be in eight or ten minutes if the oven is hot, reduce the heat. Baste meat with fat in the pan every ten or twelve minutes.

Time Required for Roasting Meats

Beef, rare, 5 lbs.	1 hour, 5 minutes.
Beef, rare, over 5 lbs.	Add 5 minutes more for each extra pound.
Mutton (saddle)	$1\frac{1}{4}$ to $1\frac{1}{2}$ hours.
Lamb (leg)	$1\frac{1}{4}$ " $1\frac{3}{4}$ "
Pork (leg)	$3\frac{1}{2}$ " 4 "
Veal (leg)	$3\frac{1}{2}$ " 4 "

Gravy for Roasted Meats

Pour excess liquid from pan in which meat was roasted. Into that which remains stir an equal amount of flour. When the flour is browned add boiling water, stirring constantly; allow one cup water for each tablespoon of flour used. Cook five minutes, stirring constantly. Season with pepper and salt. Strain.

To Broil Meats

Heat broiler and grease with some of the meat fat. Place meat in broiler with fat edge next handle. Hold over bright fire or under gas burner. Turn every ten seconds for the first minute to sear surface on both sides, thus preventing the escape of the juices. After the first minute turn occasionally. Serve in a hot platter, and spread with butter and season with salt and pepper.

Time Required for Broiling

Steak, one inch thick	4 to 6 minutes.
Steak, one and one half inches	8 " 10 "
Lamb chops	6 " 8 "
Mutton chops	6 " 8 "

Pan Broiled Beef Balls

Chop finely or scrape, as directed on page 352, two ounces of beef taken from the round. Season with salt and pepper. Shape into small balls or cakes by pressing together with the hands. Heat omelet pan, grease with butter or drippings. Put in cakes.

Turn as soon as under surface is seared. Cook five to eight minutes, turning occasionally. Sprinkle with salt and pepper. Garnish with parsley.

To Boil Meats

Wipe meat and, with the exception of salted meats like corned beef or ham, cover with boiling water. Boil for five minutes and remove scum. Place kettle where the contents will simmer but not boil until meat is tender. When half cooked season with salt. Skim occasionally and just before removing meat from fire.

To Boil Corned Beef.—Put in kettle and cover with *cold* water. Bring slowly to the boiling point. Boil five minutes. Proceed as with other meats.

To Boil Ham.—Cover with cold water and soak several hours. Wash. Cut off the hard skin near the end of the bone. Proceed as for corned beef. When ham is tender remove kettle from range and allow to stand until the water is cool. Remove ham, cut off outside skin, and sprinkle with sugar and fine cracker crumbs. Bake twenty to thirty minutes.

Time Required for Boiling Meats

Corned beef		3 to 4 hours.
Ham	12 to 14 lbs.	4 " 5 "
Mutton (leg)		2 " 3 "

To Stew Meats

Stews are generally made from second-class cuts of meat. Such meats require slow, long-continued

cooking and if allowed to boil they will become exceedingly tough. In a stew some of the juices are wanted in the meat and some in the gravy. The following are the two most common methods of stewing meat.

Stew No. 1

Wipe meat, cut in two-inch pieces, and cover with boiling water. Place the pot where its contents will simmer but not boil until the meat is tender. The tougher the meat the longer the time required for cooking but about three hours is the average. It is well to cook a small amount of bone with the meat and remove before serving. When vegetables are to be included in the stew add them, with the exception of the potatoes, when the meat is about half cooked. They are best cut in half-inch cubes. Cut the potatoes in cubes and parboil five minutes, then add to stew fifteen minutes before serving.

Make a gravy by thickening the liquid in which meat was cooked.

Allowing one teaspoon of flour for each cup of liquid, make a thin paste with cold water and then add slowly to the stew about five minutes before removing from the stove. Stir constantly until it thickens. Season with salt and pepper.

Stew No. 2

Wipe meat, cut in one- or two-inch pieces, sprinkle with salt and pepper, and dredge with flour. Try out some of the fat in a frying-pan, add the meat, and cook until the surface is seared, stirring con-

stantly. Turn meat into stewing kettle, rinse frying-pan with boiling water, and proceed as in Stew No. 1.

Warmed Over Meats

The principal points to remember in warming over meats are:

1. If the majority of meats are boiled or even allowed to stand long in hot gravy they will become tough.

2. The gravy or sauce in which they are reheated must be well seasoned. In addition to pepper and salt, celery salt, onion sauce, tomato sauce, tabasco, Worcestershire sauce, curry, or various herbs may be used.

3. The gravy should be boiling hot and properly seasoned before being added to the meat. It should be added only a few minutes before serving.

4. The meat, except veal, is best cut in very thin slices or minced that it may be readily heated through by the gravy, thus not requiring to be cooked. Veal can be cut in cubes.

The dark meats are generally prepared with a gravy or brown sauce and the white meats with a white sauce.

White Sauce

½ tablespoon butter.	⅛ teaspoon salt.
½ tablespoon flour.	½ cup scalded milk.

Mix flour and salt and add to melted butter. When well mixed add to milk and cook five minutes in double boiler.

Brown Sauce

½ tablespoon butter.
½ tablespoon flour.
⅛ teaspoon salt.
½ cup hot soup stock.
Seasonings as desired.

Brown flour in frying-pan and then proceed as for white sauce.

Sliced meat is served with or without vegetables. When vegetables are used, cook or reheat them, cut in pieces, and add to the gravy. Put in the meat and let stand for a few minutes in a warm place.

The usual ways of serving minced meat are in croustades (page 345), on toast, and on a platter with a border of mashed potato or rice. Meat and potato may be served as hash, or in a pie with either a potato or pastry crust.

SWEETBREADS

Sweetbreads keep better if they are parboiled as soon as they come from the market, and whatever the method of further cooking they always require to be first parboiled.

To Parboil Sweetbreads

Let sweetbreads stand for one hour in sufficient cold water to cover. Drain, remove fat, membrane, and pipes. Put in a saucepan of boiling water to which has been added one half tablespoon of salt and the same amount of vinegar. Boil twenty minutes, drain, plunge in cold water, and drain again.

Creamed Sweetbreads

Cut the parboiled sweetbread in small cubes.

Cover with white sauce (page 322). Stand saucepan in hot place until sweetbread is thoroughly heated.

Broiled Sweetbread

Split a parboiled sweetbread in half lengthwise. Sprinkle with salt and pepper. Broil. As soon as sweetbread is thoroughly heated and slightly browned brush with butter, sprinkle with salt and pepper, and garnish with parsley and lemon.

VEGETABLES

To prepare vegetables for cooking, wash thoroughly, and when necessary pare, peel, or scrape them.

To Wash Vegetables.—Scrub roots and tubers with a vegetable brush. Green vegetables require careful washing. To wash vegetables like spinach, first remove the roots and tough stalks, then place the leaves in a colander in a pan of cold water and toss them about until they are freed from sand and grit; change the water frequently. Place vegetables that form heads, such as cauliflower, cabbage, and Brussels sprouts, head down in cold salted water (one half tablespoon salt to a quarter of water). If there are worms in the head this will cause them to come out. The leaves should be separated or the head cut open before cooking. Green vegetables intended for salads should stand in cold water for some hours before serving, to render them crisp. All wilted and dried vegetables should be likewise treated before cooking, that they may absorb water to replace that which they have lost, otherwise they will be tough but those,

especially roots and tubers, that are not wilted, should not stand so long.

To Pare Vegetables.—Most vegetables should be pared as thin as possible. Carrots, parsnips, and other thin-skinned vegetables are scraped instead of pared. Potatoes and beets are better if cooked in their skins, as in the potato this prevents loss of salts and in the beet of colouring matter. Onions should be peeled under water or in front of an open window. Let tomatoes stand in boiling water for a minute before attempting to peel them.

To Cook Vegetables.—Vegetables may be baked, boiled, fried, roasted, or steamed. Boiling is the method most frequently used.

Boiling.—All vegetables except legumes should be put into boiling salted water (one half tablespoon for every quart of water). Sweet-juiced vegetables, like peas and carrots, should be cooked in just enough water to cover and those with a strong flavor, as cabbage and onions, in a large quantity, and the water should be changed several times, boiling water being used to replace that thrown away. The strong flavor and odour of onions and cabbage will be lessened if a little bicarbonate soda—one teaspoon to a quart—is added to the water in which they are cooked, because soda disintegrates the oil to which their pungent odour is due. In the cooking of some vegetables gases are developed, which, if retained, give them a strong taste; thus most vegetables are better if cooked at least partly uncovered, especially those with a strong flavour, but a few, as spinach, peas, and beans should be cooked covered so as to preserve their colour. Salt should not be added to any of the legumes until the vegetable is

fairly soft, for salt hardens legumen. When the legumes are old or dried or the water "hard" it is well to add a little bicarbonate of soda to the water, about one half teaspoon to every quart of water.

Do not allow the water in which cauliflower and other vegetables that are easily broken are cooked to boil violently.

Vegetables are cooked until tender, but cooking should be stopped while the vegetable is still firm. Over-cooking impairs their flavor. The time required for cooking varies with the age, size, and freshness of the vegetable; the older the vegetable the longer it must be cooked.

The following table gives the time required for boiling some of the more common vegetables:

Artichoke, Jerusalem	30 to 45 minutes.
Asparagus	20 " 30 "
Beans (dried)	1 " 3 hours.
" Lima	1 " 2½ "
" string	1 " 3 "
Beets—old	2 " 3 "
" —young	30 " 45 minutes.
Brussels sprouts	15 " 20 "
Cabbage	45 " 60 "
Cauliflower	20 " 30 "
Celery	20 " 30 "
Corn—green	12 " 20 "
Macaroni	45 " 60 "
Onions	45 " 60 "
Parsnips	30 " 45 "
Potatoes	25 " 30 "
Peas—green	30 " 45 "

Rice	20 to 45 minutes.
Salsify (oyster plant)	35 " 45 "
Spinach	25 " 35 "
Squash—summer	20 " 25 "
Squash—winter	30 " 40 "
Tomatoes, stewed	15 " 20 "

After cooking vegetables are drained and seasoned. The common seasonings are butter, pepper, and salt.

Peas, carrots, celery, etc., are often served with white sauce, and cabbage, cauliflower, corn, etc., are sometimes escalloped.

For creamed vegetables, the cooked vegetable is sliced or cut in cubes and added to the white sauce.

For escalloped vegetables put the creamed vegetable into a buttered baking dish and cover with buttered bread or cracker crumbs. A layer of grated cheese can be added before the crumbs if desired. Bake in the oven until brown.

POTATOES

Baked Potatoes

Select smooth potatoes of medium size. Scrub thoroughly and place in a hot oven. Bake until soft—about forty minutes. Pierce the skin with a fork in two or three places immediately upon removal from the oven to allow the steam to escape, otherwise the steam will condense and make the potato soggy.

Baked potatoes are more easily digested than those cooked in any other way as the starch becomes

partially changed to dextrin by the long-continued intense heat to which they are subjected.

A pretty way to serve baked potatoes is to cut the potato in half, scoop out the inside, and prepare as for mashed potato. Refill the half skins and bake in a hot oven until brown.

Mashed Potatoes

For each medium sized potato allow

½ tablespoon butter.	1 tablespoon hot milk.
⅛ teaspoon salt.	Few grains pepper.

Rice potatoes and beat with a fork while adding milk and seasonings and continue beating until mixture is creamy. Pile lightly in a hot dish.

When mashed potatoes are to be browned, as for the last recipe, it is well to add a little well beaten egg, one egg for three or four potatoes.

Saratoga Chips

Saratoga chips demonstrate the effect of allowing potatoes to stand in water, viz., the loss of starch.

Wash, pare, and slice potato as thin as possible. Let stand in a plentiful supply of cold water for two hours, changing the water twice. Drain and plunge, a few at a time, into boiling water and boil one minute. Drain, cover with cold water, let stand a few minutes, drain, and dry between towels. Fry in deep fat, keeping potato in motion while frying. Drain on brown paper. Sprinkle with salt.

SALADS

Salads may be made of almost any kind of meat, fish, vegetable, or fruit, used separately or combined.

They should be arranged daintily and attractively and served very cold.

The vegetable greens, celery, lettuce, etc., should be washed thoroughly, chilled until crisp in ice or cold water, dried, and kept in a cold place until ready to serve. They will wilt if dressing is added long before serving.

Lettuce is used with the majority of salads, as it improves both flavour and appearance. It is generally arranged as a bowl or nest to hold the salad.

Celery is a desirable addition to the majority of meat and vegetable salads. The celery tops are used for decorations. Beets are often used with meat, fish, and vegetable salads.

Eggs, hard-cooked, are used for garnishing. As a rule the whites are sliced in thin rings and the yolks forced through a strainer.

Meat Salads

To prepare meat for salad free it from bone and gristle, cut it in small cubes, mix thoroughly with French dressing, and allow it to stand for some time before combining with the vegetables. The vegetables commonly used with meat salads are celery and beets. Eggs are often used in garnishing. Add mayonnaise or cream dressing just before serving.

Fish Salad

Cold boiled fish is flaked or cut in cubes, mixed with a salad dressing, and put into a nest of lettuce leaves. Beets and celery are often included in fish salads.

Vegetable Salads

Vegetables are cooked, chilled, cut usually in dice, mixed with dressing, and allowed to stand about an hour before being arranged for serving. When different kinds of vegetable are used in the same salad it is better not to combine them until just before serving.

Fruit Salads

Some good combinations for fruit salads are:

1. Apples, celery, and nuts.
2. Oranges and bananas.
3. Oranges, pineapples, and strawberries.
4. Dates and nuts.
5. Grapefruit, pineapple, and cherries or strawberries.

Mayonnaise, cream, or wine dressings are generally used for fruit salads. They may be mixed with the fruit or used as a garnish.

Grapefruit and orange salads are often served in baskets or bowls made from the fruit peel (see page 334).

Apples, bananas, and oranges should not be cut until shortly before serving, but grapefruit and pineapple are improved by sprinkling with sugar and allowing to stand for half an hour or an hour before adding the dressing.

To prepare pineapple, pare it and cut out the eyes. Cut the soft part—the only part used—in cubes, using silver knife.

To prepare grapefruit, cut in half, with a silver knife separate the pulp from the skin and from the cross-sections, and remove, with a silver spoon.

Apples are pared and cut in dice, using silver knife.
Nuts and dates are chopped rather fine.
Strawberries and cherries are generally left whole.

Cream Cheese Salad

Mix cream cheese with dressing, make into balls. Serve on lettuce leaves. Garnish with dressing. Chopped English walnuts or pecans are often mixed with the cheese.

Egg Salad

Cut hard-cooked egg in halves. Remove yolk and mix with salad dressing. Replace in whites and serve on lettuce leaves garnished with dressing.

Jelly Salad

Tomato and meat jellies are frequently served as salads. Turn jelly on to lettuce leaf and garnish with dressing.

SALAD DRESSINGS

Boiled Dressing

½ teaspoon mustard.
¼ teaspoon salt.
1½ teaspoon flour.
2 teaspoons sugar.
Few grains cayenne.
1 egg yolk.
¾ tablespoon melted butter.
⅓ cup milk.
2 tablespoons vinegar.

Mix dry ingredients, add egg yolks slightly beaten, butter, milk, and, very slowly, the vinegar. Cook in a double boiler until mixture thickens, stirring constantly. Strain and cool.

Cream Dressing

½ teaspoon salt.
½ teaspoon mustard.
Few grains cayenne.
1 teaspoon sugar.
1 teaspoon melted butter.
2 egg yolks.
2 tablespoons hot vinegar.
⅓ cup thick cream.

Mix dry ingredients, add melted butter, egg slightly beaten, and, very slowly, the hot vinegar. Cook in double boiler until mixture thickens, stirring constantly. Strain. Add to cream beaten stiff. Chill.

French Dressing

½ tablespoon vinegar.
1 tablespoon olive oil.
⅛ teaspoon salt.
½ saltspoon pepper.

Mix all ingredients, stirring with silver or wooden salad fork until well blended.

Mayonnaise Dressing

The success of mayonnaise dressing depends largely upon having and keeping the ingredients, especially the eggs and oil, cold; on making the dressing quickly, although, in the beginning, adding the oil a drop at a time.

¼ teaspoon mustard.
½ teaspoon powdered sugar.
Few grains cayenne.
½ egg yolk.
¾ tablespoon lemon juice.
¼ tablespoon vinegar.
½ cup olive oil.

Chill the mixing-bowl and other utensils and if the weather is warm place bowl in a pan of crushed ice.

Mix dry ingredients, add egg yolk and then oil drop by drop, stirring or beating constantly until mixture thickens. Then add alternately drops of

vinegar, lemon juice, and oil, being careful not to lose the stiff consistency.

If the dressing curdles take another half yolk and slowly add the curdled mixture.

Never add mayonnaise to salads until ready to serve.

JELLIES AND CREAMS MADE WITH GELATIN

The following directions are generally given in making jellies and other mixtures stiffened with gelatin.

Soak gelatin in cold water until soft; this is called "hydrating." Dissolve in the boiling liquid and add sugar and flavouring. Strain. Orange, lemon, and other fruit jellies are generally strained through a strainer, wine and coffee through double cheese-cloth the former several times. Rinse mould in which jelly is to be placed in cold water but do not dry. Pour in jelly. Chill until jellied.

Coffee Jelly

1 teaspoon granulated gelatin.
2 tablespoons cold water.
1 tablespoon sugar.
$\frac{1}{16}$ teaspoon salt.
$\frac{1}{2}$ cup hot coffee infusion.

Lemon Jelly

1 teaspoon granulated gelatin.
2 tablespoons cold water.
4 tablespoons boiling water.
3 tablespoons lemon juice.
2 tablespoons sugar.

Meat Jelly

- 1 teaspoon granulated gelatin.
- 2 tablespoons cold water.
- ½ cup well flavoured hot broth.

Milk Jelly

- 1 teaspoon granulated gelatin
- 2 tablespoons cold water.
- ½ cup hot milk.
- 1 tablespoon Bordeaux wine.

Orange Jelly, No. 1

- 1 teaspoon granulated gelatin.
- 1 tablespoon cold water.
- 2 tablespoons boiling water.
- ⅓ cup orange juice.
- 1½ teaspoons lemon juice.
- 2 tablespoons sugar.

Orange jelly is often served in orange baskets. Mould the jelly one inch in depth in a pan. When stiff cut in cubes and fill basket.

To make basket cut two sections from upper half of orange, leaving a strip in centre wide enough for handle. Scoop out pulp from under handle and lower half of orange, taking care that the juice is not lost, as it may be used for the jelly. Keep basket in ice-box until ready for use.

Orange Jelly, No. 2

- ½ teaspoon granulated gelatin.
- 1 teaspoon cold water.

2 tablespoons boiling water.
Pulp from $\frac{1}{2}$ orange.
$\frac{1}{2}$ cup orange juice.
2 teaspoons lemon juice.
2 tablespoons sugar.
1 egg yolk.
$\frac{1}{32}$ teaspoon salt.

Soak gelatin in cold water until soft. Combine fruit juices, sugar, and yolk of egg slightly beaten. Cook in double boiler until mixture thickens, stirring constantly. Add to gelatin. Strain. Cool slightly and beat well. Add pulp. Mould. Chill and serve with orange sauce.

Orange Sauce

1 egg white.
2 tablespoons powdered sugar.
1 tablespoon orange juice.
1 teaspoon lemon juice.

Beat white of egg until stiff. Add sugar gradually and then, slowly, the orange and lemon juice.

Tomato Jelly

1 teaspoon granulated gelatin.
1 tablespoon cold water.
$\frac{1}{2}$ cup hot tomato juice.
$\frac{1}{8}$ teaspoon salt.
$\frac{1}{4}$ teaspoon sugar.
$\frac{1}{16}$ teaspoon pepper.
$\frac{1}{16}$ teaspoon celery salt.

Tomato jelly is always served as a salad on lettuce leaves, garnished with salad dressing.

Wine Jelly

1 teaspoon granulated gelatine.
1 tablespoon cold water.
2 tablespoons boiling water.
$\frac{1}{3}$ cup sherry or Madeira wine.
1 tablespoon lemon juice.
$1\frac{1}{2}$ tablespoons sugar.

Jelly Whips

Any jelly may be changed to a jelly whip. Instead of moulding, chill it until the consistency of a syrup, then place the vessel containing it in a bowl of ice and whip the mixture with a Dover egg-beater until stiff. The whip will be of a finer texture if the beaten white of egg is added to it before it stiffens. Serve with cream or cold steamed custard.

Spanish Cream (Wine)

1 teaspoon granulated gelatin.
1 tablespoon cold water.
$\frac{2}{3}$ cup milk.
1 tablespoon sugar.
1 egg.
$\frac{1}{16}$ teaspoon salt.
2 tablespoons sherry or Madeira wine.

Soak gelatin in cold water until soft. Scald milk, add to yolks of eggs slightly beaten, and then add sugar and salt. Turn mixture on hydrated gelatin. Cook in a double boiler until mixture thickens sufficiently to coat the spoon, stirring constantly. Add flavouring. Strain. Put on ice until cooled to the consistency of a syrup. Stand vessel in a dish of cracked ice and beat mixture well, then add beaten whites of eggs. Beat until stiff. Pile lightly in a glass dish. Chill. Serve with cream, or steamed custard flavoured with sherry or almond extract.

Cocoa Spanish Cream

1 teaspoon granulated gelatin.
2 tablespoons cold water.
$1\frac{1}{2}$ tablespoon sugar.
$1\frac{1}{2}$ teaspoon breakfast cocoa.
$\frac{2}{3}$ cup milk.
1 egg.
$\frac{1}{16}$ teaspoon salt.
$\frac{1}{4}$ teaspoon vanilla.

Make same as wine cream except that the cocoa, sugar, and salt are mixed with a tablespoon of boiling water and stirred until smooth and then added to the hot milk before it is added to the egg.

Coffee Spanish Cream

1 teaspoon granulated gelatin.
2 tablespoons cold water.
½ cup strong coffee.
¼ cup milk.
1½ tablespoon sugar.
$\frac{1}{16}$ teaspoon salt.
1 egg.
⅛ teaspoon vanilla.

Combine coffee and milk. Make as wine cream.

Coffee Bavarian Cream

1 teaspoon granulated gelatin.
1 tablespoon cold water.
¼ cup strong hot coffee.
1½ tablespoon sugar.
½ cup thick cream.

Hydrate gelatin. Dissolve sugar in hot coffee and add to gelatin. Strain. Let stand in ice-box until the consistency of syrup. Whip cream, add to mixture, and proceed as for Wine Cream.

Fruit juices may be used for flavouring in place of coffee.

BATTERS AND DOUGHS

Batters and doughs are mixtures of flour and liquid and as a rule such ingredients as butter, sugar, salt, etc. Mixtures are called batters when thin enough to pour or drop from a spoon and doughs when sufficiently thick to knead.

As some flours take up more liquid than others it is impossible to give a definite rule for the comparative

quantities of liquid and flour required in making batters and doughs, especially the latter, but the following table shows the general average:

Thin batter as for popovers	1 part liquid to 1 of flour.
Thick or cake batter	1 " " " 2 " "
Soft or bread dough	1 " " " 3 " "
Stiff or pastry dough	1 " " " 4 " "

Methods of Making Batters and Doughs Light

Air and gas are the two agents most commonly employed. They are used because they are expanded by heat and will thus make the mixture light and porous.

Method of Using Air.—Air is sometimes introduced into mixture by machinery, but more commonly by beating or by the addition of beaten eggs. When the lightening is entirely dependent on air the whites and yolks of the eggs are generally beaten separately, as the whites then hold the air better. The mixture must be cooked at once to prevent the escape of air.

Two eggs to one cup of flour will be sufficient to make a batter light if it does not contain much butter, sugar, or dried fruit, etc., but if any quantity of such ingredients are used the number of eggs must be proportionately increased.

Method of Using Gas.—Gas may be generated by the use of yeast or by combining an acid and an alkali, such as cream of tartar and bicarbonate of soda, sour milk and soda, molasses[1] and soda or baking powder. Baking powder is usually a combination of one part

[1] Molasses is the liquid remaining in the manufacture of sugar from sugar cane. It contains acetic and other acids, even though it has a sweet taste, as will be shown by testing with soda.

cream of tartar to two of bicarbonate of soda, with a little starch or flour. The starch is added to take up the moisture and keep the powder dry. Baking powder is very effervescent, as will be seen by the following experiment: (1) Dissolve one teaspoon of cream of tartar in half a glass of water, in a second glass put some molasses, and in a third some sour milk. Add half a teaspoon of soda to each of these. (2) Add a teaspoon of baking powder to a quarter of a glass of water.

As the formation of gas is of such short duration the fluid and dry ingredients must not be combined until everything is ready for the cooking, as the cake tins buttered, oven of right temperature, etc. The baking powder and soda are generally mixed with the flour, thus preventing too quick effervescence of the gas. In baking, as has already been stated, the gas expands, but the formation of a crust over the surface of the mixture prevents its too rapid escape, and the mixture thus becomes light and porous.

The average proportion of baking powder to flour is two teaspoons of baking powder to one cup of flour; of soda, one half teaspoon to one cup of sour milk and one teaspoon to a cup of molasses. A half teaspoon of baking powder is equivalent to one egg and may sometimes be substituted for it. A larger quantity of baking powder is used if the batter contains any amount of butter, etc., but it is better to increase the number of eggs rather than the quantity of the baking powder, as if too much of the latter is used the soda will flavour the food.

Yeast.—Yeast, like bacteria is one of the lowest forms of vegetable life. It grows by budding. When

put into a suitable mixture, *i.e.*, one which is moist and contains protein and carbohydrate substances, and kept at a favorable temperature—70° to 90° F.—the yeast will grow very rapidly and will cause the sugar, into which the diastase present in the yeast has converted a part of the starch, to ferment, with the consequent formation of alcohol and carbon-dioxide. It takes some hours for the gas to develop, the length of time depending on the amount of yeast and the ingredients in the mixture. Rich batters and doughs which contain butter, egg, or dried fruit will take longer to "rise." The addition of a little sugar will hasten the action of the yeast. The temperature around the mixture is important; if the latter is in a draft or at too low a temperature—below 70° F.—the action of the yeast is retarded, if in too warm a place—above 90° F.—the bread will "rise" too much and in consequence will be coarse and full of holes. If the heat is too great the yeast plant will be killed. If the dough is allowed to "rise" too long, the fermentation process will be extreme and the dough may become sour.

Popovers

Popovers are an example of a thin batter made light by the incorporation of air.

½ cup flour.	1 egg.
⅛ teaspoon salt.	¼ teaspoon melted butter.

10 teaspoons milk.

Mix salt and sifted flour, add milk gradually. Separate white from yolk of egg, beat both until light. Add yolk to the batter, fold in the whites, add butter,

beat mixture two minutes, using Dover egg-beater. Turn immediately into hot earthen cups or iron gem pans and bake thirty to thirty-five minutes.

Baking Powder Biscuit

Baking powder biscuit are an example of dough made light by formation of gas by use of baking powder.

$\frac{1}{2}$ cup flour.	$\frac{1}{2}$ tablespoon butter.
1 teaspoon baking powder.	3 tablespoons milk.

$\frac{1}{8}$ teaspoon salt.

Mix and sift dry ingredients twice. Cut in the butter, add milk gradually. Toss mixture on a floured board, using as little flour as possible, roll lightly to one half inch in thickness. Shape with a biscuit-cutter. Place in a buttered pan and bake twelve to fifteen minutes in a hot oven.

Emergency Biscuit

Make in same manner as Baking Powder Biscuit, but use a little more milk, sufficient to allow of the mixture being dropped from a spoon. Drop by spoonfuls into a buttered muffin pan.

Cake

Cake may be made light either by the incorporation of air, as in sponge cake, or with both air and gas, as in butter cakes.

Before making cake be sure that all materials are at hand, that the oven is the right temperature, that the pans are greased and dredged with flour. For

cakes which require a long baking the pan is lined with greased paper to prevent burning in the bottom.

When filling pans make mixture higher on the sides than in the centre, as it rises more in the centre.

To Bake Cake.—The best-mixed cake may be ruined in baking. If the oven is too hot a crust will form before the cake has risen sufficiently, and that will cause a break in the centre and make an unsightly loaf. The crust will also become too hard before the cake is cooked in the middle. If the oven is too cool the cake will rise too much and will consequently have a coarse texture.

If the oven is of the right temperature the cake will rise but not brown during the first quarter of the time required for baking; it will become slightly brown during the second quarter, well browned during the third, and during the last quarter it will shrink from the sides of the pan and will then feel firm to the touch.

Persons not accustomed to baking sometimes insert a clean hot darning needle or whisk straw. If the straw is clean when removed the cake is sufficiently cooked. When cake is baking be careful not to jar it or open the oven door too wide. If the cake browns too rapidly cover with a piece of buttered paper.

Sponge Cake

3 eggs.	1 teaspoon lemon juice.
½ cup sugar.	¼ grated lemon rind.
½ cup flour.	Speck of salt.

Separate yolks from whites. Beat yolks until thick and lemon-colored, add sugar, lemon juice and rind. Beat whites until stiff and fold into yolks. Fold in

flour sifted with salt three times. Bake forty minutes in a slow oven.

1 2 3 4 Cake

This is an example of a butter cake. It has been chosen because the comparative proportions of ingredients are easy to remember.

1 cup butter.
2 cups sugar.
3 cups flour.
4 eggs.
1 cup milk.
4 teaspoons baking powder.
1 teaspoon vanilla or other flavouring.

For a Small Cake

¼ cup butter.
½ cup sugar.
1¼ cup flour.
1 egg.
1 teaspoon baking powder.
¼ cup milk.
¼ teaspoon vanilla or other flavouring.

Cream butter thoroughly, add sugar gradually, and when well mixed add yolks beaten until lemon-coloured and thick. Sift flour three times, adding baking powder the last time. Add this mixture alternating with the milk. Add flavouring and fold in whites beaten until stiff. Turn into buttered cake tin. Bake forty minutes.

Bread

½ cup scalded milk.
½ cup boiling water.
½ tablespoon lard.
½ tablespoon butter.
¾ teaspoon salt.
1 teaspoon sugar.[1]
½ cake Fleischman's yeast.
⅛ cup lukewarm water.
3 cups sifted flour.

[1] The sugar is used to hasten action of yeast and not as sweetening.

Put lard, butter, salt, and sugar in bowl or bread-raiser, add milk and boiling water. When lukewarm add yeast cake which has been dissolved in lukewarm water. Add sufficient sifted flour to prevent dough sticking to fingers, and unless bread-raiser is used toss on a floured board and knead until elastic to the touch and bubbles can be seen under surface, when cut with a knife. Put back into bowl, brush over with melted butter,[1] cover, and set in a warm place (70° F.) until it doubles in bulk, which with the amount of yeast[2] used in this recipe will be in about two hours. The bread is then kneaded a second time until the gas is evenly distributed and there are no large bubbles.

Use as little flour as possible in this kneading. If the dough adheres to the hands rub them with a little soft butter. Shape the dough into loaves. (This quantity will make a good-sized loaf.) Put into a greased bread-pan and set to rise until loaves double in bulk. Put into a hot oven (400° F.) for the first ten or fifteen minutes and gradually decrease the heat. When cooked the loaf will feel light, will sound hollow if tapped with the finger, and will leave the pan readily. If a shiny surface is desired brush the top of the loaf with melted butter before removing from the oven. When baked remove from pan and place on a wire cake-cooler. If a soft crust is desired keep the bread covered with a towel while cooling.

[1] To protect from air and so prevent the forming of a crust.

[2] When dough is set to rise over night only half as much yeast is used.

Cake for Diabetic Patients—Almond Cake

$\frac{1}{4}$ cup blanched almonds.
1 tablespoon cold water.
1 teaspoon vinegar.
1 tablespoon melted butter.
Yolks 2 eggs.
$\frac{1}{8}$ teaspoon baking powder.
A few grains salt.

Bake almonds in moderate oven until light brown. Grate. Pour water mixed with vinegar over them. Let stand two minutes. Strain. Dry in oven. Crush to a fine powder. Add butter, yolks of eggs, beaten until thick and lemon-coloured, baking powder, and salt. Fold in whites of eggs beaten until stiff and dry. Turn mixture into buttered gem tins and bake twenty-five minutes in a slow oven.

USES OF STALE BREAD

In institutions especially there is a constant supply of stale bread to be utilized. It may be used for crumbing croquettes, and other fried dishes, garnishing, toast, scalloped dishes, stuffing for poultry, meat, and fish, and puddings.

To Prepare Bread for Crumbing

Slice and place in a slow oven until dry. Crush with a roller. Keep in a clean air-tight jar.

Bread for Garnishing

1. Remove crusts, cut into various shapes as cubes, oblongs, triangles, etc., and toast. 2. Croustades: Remove crust, cut bread in two-inch slices and shape into cubes. Remove centre, forming a box. Fry in deep fat or brush with butter and brown in the oven.

These cases are filled with creamed or minced meat or fish, or such vegetables as peas, spinach, etc. 3. Croûtons: Remove crusts and cut bread in half-inch cubes. Fry in deep fat or brown in oven. Serve with soup.

Toast

Dry Toast. — Cut stale bread in one-fourth-inch slices. If crusts are to be removed or toast shaped, do so before toasting. To prevent the toast being "soggy" in the inside it may be dried in a slow oven or held some distance from the flame, or if a gas stove is used the bread may be placed on a steel-covered asbestos mat and the flame turned low. In this way the excess moisture is driven off and the bread dried through before the outer surface is browned. When sufficiently dry the bread should be held nearer the flame and browned quickly. Toast so made must be served immediately, as it will soon become hard. This toast is easily digested, being in fact partly predigested or dextrinised.

Milk Toast

Place two slices of toast in a hot sauce dish and pour on one third cup scalded milk seasoned with one eighth teaspoon salt. The toast may be buttered if desired.

Cream Toast

2 slices toast.	$\frac{1}{3}$ cup hot milk.
1 teaspoon butter.	$\frac{1}{8}$ teaspoon salt.

1 teaspoon flour.

Cut the toast in strips. Dip in hot salted water

and place in hot sauce dish. Cover with white sauce made of remaining ingredients (page 208).

Bread Pudding

A variety of puddings may be made from stale bread and when well made are very palatable. The common causes of failure are that the bread is not crumbled sufficiently fine, that it is not soaked long enough in the hot milk, or that the crusts are not removed, or an insufficiency of eggs.

Bread-and-Apple Pudding

3 cups stale bread-crumbs.
1 tablespoon melted butter.
1 large apple pared and thinly sliced.
1½ tablespoon sugar.
¾ tablespoon water.
⅛ teaspoon salt.
A little grated nutmeg and cinnamon.

Mix bread-crumbs and butter. Mix apples, water, sugar, and spice. Put alternate layers of bread and apple mixtures in a buttered pudding dish having crumbs at both top and bottom. Bake twenty to twenty-five minutes in a moderate oven. Serve with hard sauce or whipped cream.

Bread-and-Butter Pudding

2 or 3 half-inch slices of buttered bread.
⅔ cup scalded milk.
1 egg.
1 tablespoon sugar.
⅛ teaspoon salt.
¼ teaspoon vanilla.
¼ cup currants and raisins.

Beat egg slightly, add milk, sugar, salt, and flavouring. Cut bread in strips and remove crusts. Put layer of bread in buttered baking dish, pour on a

little of the milk mixture, and add a layer of currants and raisins. Repeat layers until pudding dish is filled. Have bread with buttered side uppermost for top layer. Let stand twenty minutes. Grate a little nutmeg over top. Bake twenty-five minutes in a moderate oven. Serve with cream or hard sauce.

Bread-and-Cheese Soufflé

Proceed as for Bread-and-Butter Pudding, but substitute grated cheese for currants and raisins, and omit sugar.

Chocolate Bread Pudding

- $\frac{1}{4}$ cup stale sifted bread-crumbs (no crusts).
- $1\frac{1}{4}$ tablespoon sugar.
- $\frac{1}{3}$ square melted chocolate.
- $\frac{2}{3}$ cup scalded milk.
- 1 egg.
- $\frac{1}{8}$ teaspoon salt.
- $\frac{1}{4}$ teaspoon vanilla.

Melt chocolate, add sugar and salt, and add to milk. Pour over bread-crumbs and let stand twenty minutes. Separate yolks and whites and put in ice-box. Beat yolks slightly and add to mixture. Add flavouring and turn into buttered pudding dish. Bake in a moderate oven thirty to forty minutes. When cold cover with red currant jelly or other preserved fruit and meringue. Serve cold with cream.

Meringue

Add one eighth teaspoon salt to white of one egg. Beat until stiff. Add one tablespoon confectioners' sugar and one half teaspoon vanilla or other flavouring and beat well. Pile lightly on top of pudding and brown slightly in the oven.

Orange Bread Pudding

¼ cup stale sifted bread-crumbs (no crusts).
1½ tablespoon sugar.
2 tablespoons orange juice.
½ orange.
⅔ cup scalded milk.
1 egg.
⅛ teaspoon salt.
½ teaspoon butter.
Nutmeg.

Mix nutmeg, salt, half the quantity of sugar and bread-crumbs. Add scalded milk and let stand twenty minutes. Separate yolks from whites and keep the whites cool for meringue. Add beaten yolks to mixture and then the orange juice. Put a layer of bread mixture in a buttered pudding dish. Cover with thin slices of orange and sprinkle with sugar. Repeat layers until pudding dish is full, having bread mixture for top layer. Cut butter in small cubes and place at regular intervals on top of pudding. Bake thirty to thirty-five minutes in a moderate oven. When cold cover with meringue. Serve with cream or orange sauce.

Queen of Puddings

¼ cup stale sifted crumbs.
1½ tablespoon sugar.
⅛ teaspoon salt.
2 teaspoons lemon juice.
⅔ cup scalded milk.
1 egg yolk.
Nutmeg.
Currant jelly.

Mix bread-crumbs, salt, and sugar. Add scalded milk and let stand twenty minutes. Beat well and add yolk of egg slightly beaten. Add lemon juice and grate nutmeg over the top. Bake thirty to thirty-five minutes in a moderate oven. When cold cover top with jelly and meringue.

SAUCES TO SERVE WITH BREAD PUDDING

Hard Sauce

½ tablespoon butter.
1½ tablespoon powdered sugar.
¼ teaspoon vanilla or almond extract or 1 tablespoon sherry.

Cream the butter, add the sugar gradually, stirring constantly. When thoroughly mixed and creamy stir in the flavouring.

Orange Sauce

1 egg white.
½ cup powdered sugar.
½ orange juice and rind.
1 teaspoon lemon juice.

Beat white until stiff and dry. Add sugar slowly, stirring constantly. Beat well and add rind and fruit juice.

SANDWICHES

Sandwiches may be made from white bread, whole wheat bread, brown bread, toasted bread, or crackers, with various fillings, which are usually better if made into a paste. The bread should be of a close texture and twenty-four hours old. There will be less waste if a square-shaped loaf is used.

To Prepare Sandwiches.—Cut the bread as thin as possible and turn loaf after cutting each two slices. Keep slices in pairs as they are cut. Cream butter until soft enough to spread without tearing bread. Slice may be buttered before cutting from loaf. Spread one slice with butter and other slice with a filling. Press lightly together, trim off the

crusts, and cut the sandwiches in the shapes desired —squares, oblongs, triangles, etc.

Lettuce and other greens that will wilt should not be put in sandwiches long before serving.

Sandwiches will remain fresh for several hours if wrapped in paraffine paper or in a damp napkin or towel and kept in a cold place.

Layer Sandwiches

Place slices of buttered white and brown bread in alternate layers, making a loaf two and a half inches in thickness. Remove crusts and cut in half-inch slices.

A filling may be placed between slices if desired.

FILLING FOR SANDWICHES

Dressing for Filling

½ teaspoon mustard.	Few grains cayenne.
¼ teaspoon salt.	1 egg yolk.
1½ teaspoon flour.	¾ tablespoon melted butter.
2 teaspoons sugar.	⅓ cup milk.

2 tablespoons vinegar.

Mix dry ingredients, add yolk of egg beaten slightly, butter, milk, and the vinegar very slowly to prevent curdling. Cook in double boiler until mixture thickens. Strain and cool.

Cheese Filling

Grate any mild cheese and mix with sufficient boiled dressing to season. Chopped English walnuts, pecans, olives, gherkins, etc., may be added if desired.

Egg Filling

Force yolks of hard-boiled eggs through a strainer. Cut whites in small, very thin slices, combine with yolk, and mix with sufficient dressing to season.

Fruit and Nut Filling

Chop dates or raisins and nuts very fine. Moisten with dressing.

Ham Filling

Mince ham and moisten with Tartar sauce or dressing.

Lettuce Filling

Wash and dry thoroughly small, fresh, crisp lettuce leaves. Cover leaves with mayonnaise or dressing.

Sardine Filling

Remove bones from canned sardines and mix with dressing to form a paste.

Scraped Beef Filling

Wipe a piece of steak from top of round and cut in strips one fourth inch in thickness. Remove the soft part of meat from connective tissue by scraping the meat on both sides, using a silver spoon. Scrape with grain of meat. Unless the patient's condition counterindicates their use, season with pepper and salt.

ICE CREAMS, ICES, AND SHERBETS

Certain frozen foods are of great value in feeding the sick, as they will often be retained when the stomach will not tolerate any other form of nourishment. Broth, custard, cream, egg-albumen, and milk may all be served in this way. When frozen they should be given between meals or with a very light meal, as intense cold retards digestion.

Physics of Freezing.—The usual method of freezing cream, etc., is effectual because the salt, on account of its affinity for water, forces the rapid thawing of the ice, and as heat is required for this process, that of the freezer and of its contents is abstracted and the latter freezes.

Proportions of Salt to Ice.—When a fine-grained texture is desired use one part salt to three of ice; when a coarse or granular consistency is required, as for frappé, use equal parts salt and ice.

How to Freeze and Pack.—Mixtures increase in bulk during freezing, therefore fill the can only to three fourths of its capacity. Surround the can an inch higher than its contents with alternate layers of ice and salt. The smaller the lumps of ice the quicker they will be affected by the salt and consequently the more rapidly the mixture in the can will freeze. It will also freeze quicker if the freezer crank is turned slowly until the mixture becomes a mush, as it is exposed to the cold longer at a time.

During the freezing add more ice and salt if necessary, but do not draw off the water unless there is danger of its getting into the can.

When the mixture is frozen draw off the water,

remove the dasher, pack the mixture solidly by pressing it down with a spoon, replace the cover, insert a cork in the dasher-hole, pack ice and salt around and over the can, using one part salt to four of ice; cover the whole with thick paper, sacking, or old carpet, and let stand in a cold place until ready to serve.

How to Freeze without a Freezer.—Put mixture into a water-tight baking powder tin, small pail, tin cup, glass jar, or tumbler. Set this in a large pail or bowl, surround with ice and salt in correct proportions, and cover. Turn the can or jar with the hand and occasionally remove the cover, scrape the mixture from the sides of the can, and beat.

ICE CREAM

Ice cream may be made of pure cream or of varying proportions of cream and custard. The custard is sometimes thickened with corn-starch, but, for invalids especially, it is better without.

To make the custard, follow the recipe for a thin steamed custard given on page 175. If the cream is whipped slightly before being added to the custard it will make a richer and thicker cream.

Cream to be whipped should be very cold before whipping is started. Pour into a cold bowl and whip with an egg-beater or cream-whipper. A very small quantity of cream is easier whipped with a silver fork.

When fruit is used for flavouring, cut it in small pieces, sprinkle with sugar, and allow to stand some time before adding to the cream.

Plain Ice Cream

½ cup thin cream.
1 tablespoon sugar.
⅓ teaspoon flavouring.
Few grains salt.

Mix ingredients and freeze.

Chocolate Ice Cream

¼ square chocolate.
1 tablespoon sugar.
1 tablespoon boiling water.
½ cup thin cream or cream and custard.
1/16 teaspoon salt.
Few drops vanilla.

Melt chocolate in sauce-pan over hot water, add boiling water, and bring to boiling point. Add sugar and cream gradually, stirring constantly. Add salt and vanilla. Freeze.

Coffee Ice Cream

1½ tablespoon ground coffee.
⅓ cup milk.
1¼ tablespoon sugar.
Few grains salt.
⅓ cup cream or cream and custard.

Add coffee to milk and cook in double boiler five minutes. Add sugar, strain, and then add cream and salt. Chill. Freeze.

Strawberry Ice Cream

¼ cup strawberries, washed and hulled.
½ cup thin cream or cream and custard.
2 tablespoons sugar. Few grains salt.

Sprinkle strawberries with sugar and let stand at least half an hour. Wash and rub through strainer. Add cream and salt. Freeze.

Peaches, pineapple, raspberries, etc., may be treated in the same manner, using less sugar for sweet fruit.

ICES

Lemon Ice

¼ cup sugar. ½ cup boiling water.
2 tablespoons lemon juice.

Boil sugar and water together ten minutes. Add lemon juice. Strain. Freeze.

Orange Ice

¼ cup sugar. ½ cup boiling water.
¼ cup orange juice. 2 teaspoons lemon juice.

Make in same manner as lemon ice.

SHERBET

Proceed as for lemon or orange ice, but after syrup has been frozen to a mush add one tablespoon of sherry or other wine and half the white of an egg beaten until stiff but not dry. Mix well and continue freezing.

TEA, COFFEE, COCOA, AND CHOCOLATE

Tea

Allow "1 teaspoon of tea for each cup of tea and one for the pot."

Use freshly boiled water.

Scald teapot. Put in tea and let stand a few seconds. Add boiling water. Let stand in a warm place from three to five minutes before serving.

When a tea-ball is used warm the tea in an oven having low heat. The dry heat develops the flavour of the tea.

For Russian tea serve with lemon.

For iced tea pour boiling lemonade over the tea leaves. Let stand five minutes. Strain. Cool. Add ice.

Coffee (Filtered)

2 tablespoons finely ground coffee.
1 cup freshly boiled water.

Scald coffee-pot. Put coffee in upper part of double coffee-pot and pour on boiling water. Let stand in a warm place until water filters through. Refilter if a stronger coffee is desired.

If only a small quantity is desired it may be filtered through a piece of filter paper or muslin.

Coffee (Boiled)

2 tablespoons coffee. ¼ cup cold water.
½ teaspoon egg white[1] or a crushed eggshell.
1 cup boiling water.

Mix coffee, egg or shell, and half the quantity of cold water. Turn into scalded coffee-pot, pour on boiling water, and stir. Let boil three minutes. Pour out a little coffee, to free spout from grounds; add remaining cold water[2] and let coffee stand for ten minutes in a place where it will keep hot, but not boil. If there is no cap to the spout of the coffee-pot, plug it to prevent escape of aroma.

The size of the coffee-pot should be in accordance

[1] White of egg is added to clear coffee. When it boils the albumen is coagulated and gathers the particles and sediment in masses.

[2] Cold water, being heavier than hot, sinks to the bottom taking the grounds with it.

with the quantity to be made; it is almost impossible to make a small quantity of coffee in a large pot.

Chocolate

$\frac{1}{4}$ square unsweetened Baker's chocolate.
1 tablespoon sugar.
$\frac{1}{4}$ cup boiling water.
$\frac{3}{4}$ cup scalded milk.
$\frac{1}{4}$ teaspoon vanilla.
$\frac{1}{16}$ teaspoon salt.

Melt chocolate over hot water. Add sugar, salt, and water gradually. Boil one minute, stirring constantly, and add to scalded milk. Reheat and beat with Dover egg-beater for two minutes. This is called milling; it makes the chocolate light and prevents the formation of a scum. Add vanilla. Serve with or without whipped cream.

Cocoa

$1\frac{1}{2}$ teaspoon breakfast cocoa.
$1\frac{1}{2}$ teaspoon sugar.
$\frac{2}{3}$ cup scalded milk.
$\frac{1}{16}$ teaspoon salt.
$\frac{1}{4}$ cup boiling water.

Mix dry ingredients, add water gradually, and boil one minute, stirring constantly. Turn on to scalded milk and mill in same manner as chocolate.

Eiweissmilch (Casein Milk)

4 teaspoonfuls of essence of pepsin.
1 quart of milk
1 pint of water.
1 pint of buttermilk.

Make junket as directed on page 282, using 4 teaspoonfuls of essence of pepsin to a quart of milk. When the latter is clotted, cut the clot with a silver knife and turn it into a fine strainer, lined with three

or four folds of fine cheesecloth, and let it stand until all the whey has drained off. Then scrape the curd from the cloth into the strainer and, with a spoon, press it through the strainer into a suitable utensil. During this process, add some water from time to time, using a total of 1 pint. (The resulting liquid should look like milk with a very fine precipitate.) Add 1 pint of buttermilk.

Martin's Milk

1 quart fresh skimmed milk. ½ of a junket tablet.
1 tablespoon cold water.

Heat milk to 100° F., dissolve tablet in cold water, add to milk. Let mixture stand until milk curds, then beat with Dover egg-beater until it is of the consistency of a thick cream and free from lumps.

Malt Soup

Wheat flour 1½ ounces.
Cold water 12 ounces.
Milk 16 ounces.
Malt soup-extract 1½ ounces.
Hot water 4 ounces.

Mix the flour with the cold water. Cook ten minutes in double boiler, stirring constantly. Dissolve malt soup extract in hot water, and add slowly to flour mixture. Allow to stand ten minutes, in order that it may be partially dextrinized. Add milk and bring whole to boiling point. Strain.

GLOSSARY

Acid.—A substance which neutralizes a base, decomposes a carbonate, and reddens blue litmus.

Activator.—An inorganic substance that activates zymogens.

Affinity.—The force which causes and maintains combination of elements.

Alkali.—A substance which neutralizes an acid, saponifies fat, and turns red litmus blue.

Anabolism.—Constructive metabolism.

Assimilated.—The act of absorbing nutriment.

Atom.—The smallest particle of an element that can exist.

Catabolism.—A retrograde change in the tissues of the body. Destructive metabolism.

Catalyzer.—A substance which changes the velocity of a reaction, but does not initiate it nor change its products.

Cholin.—A nitrogenous compound.

Cleavage.—Division into parts.

Colloids.—Glutinous substances; non-crystalline substances. Colloidal substances will not pass through animal membranes.

Crystalloids.—Soluble substances the molecules of which are relatively small and are capable of diffusing through a membrane such as parchment.

Dehydration.—The condensation of two molecules into one with the loss of water; example, the building up of a starch molecule from a monosaccharide.

Diastase.—An enzyme that helps in the conversion of glycogen and starch to glucose.

Diffusion.—When two or more mixable liquids are brought into contact, or if divided only by a permeable membrane, they will soon combine. This interpenetration of substances is called diffusion; it is due to the continual movements of the gaseous or liquid molecules.

Fermentation.—Decomposition of complex molecules under the influence of enzymes or ferments.

Hormones.—Secretions which, after absorption into the blood, stimulate the secreting action in other organs.

Hydrolysis.—The splitting of a compound substance due to the absorption of water.

Hydroxid.—Any compound of hydroxyl with another radical.

Hydroxyl.—The radical OH.

Isomer.—A substance composed of the same elements, in the same proportion as another substance, but somewhat different in nature due to difference in the arrangement of the elements within the molecule.

Kinase.—An organic substance that activates zymogens; example, the enterokinase of the intestinal juice, which activates trypsinogen.

Molecule.—The smallest particle of any compound.

Mucin.—Slimy substances secreted by epithelium; example, the mucin of the saliva.

Nucleo-proteids.—The chief constituent of cell-nuclei, found in greatest abundance in glandular organs. They are compounds of proteids, nucleic acid, and phosphorus.

Neutralization.—The interaction of an acid and a base, resulting in the formation of a salt.

Nitrogen Equilibrium.—Nitrogen forms 16 per cent. of the protein molecule, therefore to determine if the body is getting sufficient protein food the excreta is analyzed and the amount of nitrogen therein determined. If there is the same per cent. of nitrogen in the excreta as in the food eaten the body is said to be in *nitrogen equilibrium;* that is, it is getting as much nitrogen from food as is required to replace tissue waste. On the other hand, if there is less nitrogen in the urine than was taken in food, the body is storing nitrogen—this happens under normal conditions during the period of growth and in convalescence from disease, —and if there is more excreted than was contained in the food eaten the body must be losing nitrogen.

Nucleated.—Having a nucleus or nuclei.

Nucleus.—(Pl. nuclei). The spheroid body near the center of a cell which is essential for the life and dividing of the cell.

Optimum.—Most favourable.

Organic.—Complex compounds of carbon. Applied to natural or artificial products from animal or vegetable life.

Osmosis.—Diffusion through membranes.

Oxidation.—The addition of oxygen to any substance.

Oxide.—Compound of oxygen with one other element.

Permeable.—Permitting penetration.

Phenolphthalein.—A coal tar derivative that is turned red by alkalies.

Purin-bases.—Substances resulting from the metabolism of nucleo-proteins, either of food or body tissue. Those resulting from body tissue are called endoge-

nous; those, from food, exogenous. The more common purin bodies are hypoxanthin, xanthin, uric acid, guanin, adenin, caffein, theobromine.

Radical.—A group of elements forming part of a molecule, and acting as a unit in a chemical reaction; example, the OH radical of NaOH sodium hydroxide.

Reaction.—A chemical change.

Reagent.—A mixture or compound used to produce a desired chemical change.

Reducing agents.—Substances which have such a strong affinity for oxygen that they combine with it readily and thereby cause reduction.

Reduction.—The taking away of oxygen from a substance.

Retrograde.—Receding or going backward.

Saponification.—Simplification with absorption of a hydroxide. Saponification can only take place when one of the molecules forming the complex is an organic acid—such as is in fat. Because the agent of saponification, KOH or other hydroxide, is a base and can only react with an acid.

Substitute.—To replace one element or group with another.

Synthesis.—The process of forming a compound from its constitutional parts.

Volatile.—Applied to substances which easily change into vapour.

Zymogens.—Enzymes that exist in the cell in an inert form and become active only when activated by a kinase; example, the trypsinogen of the pancreatic juice.

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